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Commercial Fisheries REVIEW

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Commercial Fisheries REVIEW

A comprehensive view of United States and foreign fishing industries — including catch, processing, marketing, research, and legislation — prepared by the National Marine Fisheries Service.

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OUR OCEAN PRIORITIES ARE CHANGING, NOAA HEAD SAYS

In the 7 fiscal years 1967-1973, total Federal investment in marine-science activities has increased 53%--from $438 million to $672 million--Dr. Robert M. White, NOAA Administrator, told the Marine Technology Society in Washington, D.C., on May 15. During these years, the total Federal Research and Development budget rose only 16%--from 16 billion to 18.6 billion.

Significant, too, Dr. White noted, was the trend since 1967 in the investment of Federal money. In the first half of the period, there was an increase of $75 million; in the second, $159 million. "The growth rate appears to be accelerating," he said.

Priority and Importance

As a percent of annual ocean expenditures, national security programs "suffered the greatest loss in relative priority." In 7 years, these dropped from 37% of total effort to only 14%.

Dr. White stated: "Our National expenditures for both living and nonliving resources, ocean monitoring and prediction, mapping and charting, general purpose engineering, and education, were relatively constant as percentages of the total."

The big gainers were 3 major program areas: coastal zone, from 5% to 14% of total, marine transportation, from 3% to 10%, and general-purpose ocean research, from 14% to 19%. "These numbers reveal a very clear reordering of our national ocean priorities," Dr. White asserted.

Greater emphasis on the Coastal Zone reflects the growing national demand to protect the environment. It conforms to the purposes of the Environmental Policy Act of 1969, the clean Water Act of 1969, pending legislation on Ocean Dumping, Coastal Zone Management, etc.

In 6 years, the budget for coastal-zone activities increased from $21 million to $94 million.

MARINE TRANSPORTATION

Greater emphasis on transportation reflects 3 factors: increasing U.S. concern with its economic position in the world; U.S. attempts through research and technology to create again a merchant marine fleet equal to its growing needs; expansion of Coast Guard enforcement of marine law.

The budget for marine transportation rose from $12 million to $70 million.

GENERAL-PURPOSE OCEAN RESEARCH

Ocean research mirrors the policy of the Resources and Engineering Act of 1966. It represents U.S. determination "to seek the understanding of the oceans which underpins all else that we seek to do."

Ocean research increased 100% from $62 million to about $126 million. In fiscal year 1973, this research--19% of the total--is the largest slice of the ocean-budget pie.

Several ocean activities that increased at a much faster rate than the average included

those involving living and nonliving ocean resources. Fishery activity rose from $38 million to $62 million, a gain of 62%. Nonliving-resource activities gained 181% from $7 million to $20 million.

Dr. White singled out two programs as "candidates for greater emphasis in the future. . .Our National programs directed at the exploration, development and conservation of our nonliving and living resources." He believes their growth in recent years reflects "the growing realization that the oceans offer substantial hope for meeting some of our pressing National resource needs."

At the same time, there is growing realization that our living resources have to be protected. This will push us towards a comprehensive living-resource management system. We need new technologies of fish-stock assessment, new understanding of pollution's effects on marine ecosystems, and national systems of fishery resource management through new institutions. This development will underscore the need for greater investments to protect and manage our invaluable resources.

And the NOAA Administrator saw this prospect:

"We in the marine field have a new climate and a new opportunity for innovation in marine industry. The oceans offer excellent opportunities of substantial potential--aquaculture, marine mining technology, and environmental preservation, to name a few. And I see encouraging opportunities arising for collaborative work between the Government and industry. I believe that these kinds of opportunities will be among the principal determinants of the nature of the National ocean program over the next six-year period."

NMFS PREDICTS GOOD ALBACORE FISHING SOUTH OF SAN FRANCISCO

The best location for catching albacore tuna this year will be south of San Francisco, according to Dr. R. Michael Laurs of the NMFS Laboratory in La Jolla, California. Dr. Laurs is in charge of fishery prediction investigations.

He bases his forecast on environmental conditions and the trend over the years in distribution of the commercial albacore catch. He estimates that 70 to 80% of the 1972 catch will be south of San Francisco, with most of it off central California; 20 to 30% is expected to come from waters north of San Francisco, which is below the long-term catch average of 36%.

Catch Predictions

Commercial boats fishing south of San Francisco can expect to catch 30 to 45 million pounds of the valuable white-meat tuna; boats north of San Francisco may catch 10 to 15 million pounds. Dr. Laurs cautions, however, that these estimates could be low if many more boats enter the fishery.

Weekend fishermen and sport boats in southern California waters should have very good albacore fishing this season, although the development of warm water conditions in late summer could limit fishing success.

Role of Environmental Conditions

The prediction of the fishery's general distribution was developed by Dr. Laurs and his staff of meteorologists, oceanographers, and biologists. It is based partly on an experimental index that relates the north-south coastal distribution of the fishery with environmental conditions in certain offshore waters during spring. This assumes that midocean environmental conditions encountered by incoming migrant albacore affect their distribution when they enter North American waters. In past years, the albacore prediction was based solely on analysis of sea-surface temperature conditions in spring in near-shore waters; the summer albacore fishery traditionally takes place there. Biologists assumed that trends in environmental conditions observed in spring persisted and indicated the probable distribution of sea-surface temperature in midsummer. However, later research has shown that dynamic air-sea interactions during summer can alter considerably the sea-surface temperatures seen in spring prior to the fishing season--and alter albacore distribution.

"In the near future, Dr. Laurs stated, "our current population dynamics research should enable us to make more accurate forecasts of tonnage and general size of albacore that will enter the fishery."

NMFS INSPECTS AREA AFFECTED BY CANNIKIN NUCLEAR TEST

Four biologists-divers of the NMFS Auke Bay Fisheries Laboratory in Alaska made a series of reconnaissance dives at Amchitka Island in late April 1972 to determine the extent of underwater biological and geological effects of the detonation in November 1971 of a 5-megaton nuclear device. The divers were Louis Barr, Roy Martin, John Karinen, and Robert Budke. They were accompanied by Theodore R. Merrell Jr., environmental research coordinator for the Auke Bay Laboratory.

Ten locations off the Bering Sea coast within 3 km of Cannikin ground zero were inspected. Six of the locations showed shock-caused bottom disturbances in the form of broken bedrock outcrops. At some sites, damage was slight but, at others, extensive severe damage occurred.

Greatest Damage

The area of greatest damage was along the margin of a large offshore reef about 1.7 km from ground zero. The reef consists of a rock pinnacle that rises precipitously from a depth of about 10 to 15 meters to the sea surface. The basal margin of the reef was littered with freshly broken large rocks, some more than 3 meters in diameter, which apparently were broken from the reef by the shock of the Cannikin explosion. The newly exposed surfaces of broken rock were readily apparent because they were uneroded and unencrusted by marine organisms.

Biological Changes

Biological changes occurring in the disrupted areas are of two types: disappearance of organisms from previously exposed rock

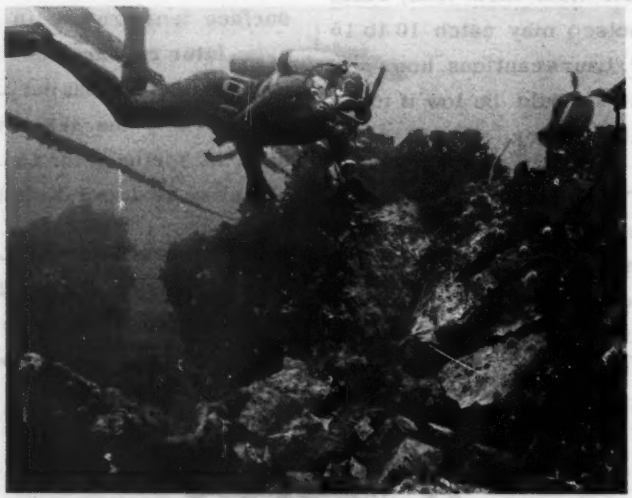


Fig. 1 - Diver inspecting a small underwater rock fall caused by the shock of Cannikin, a 5-megaton nuclear test at Amchitka Island, Alaska. Rock falls of this size and larger were common in an area off the Bering Sea coast of Amchitka adjacent to the test site.

Fig. 2 - Diver at base of a precipitous underwater cliff in an area off Amchitka Island undamaged by the Cannikin test. Closer to the test site, cliffs such as this suffered extensive breakage.

surfaces, and colonization by plants and animals of newly exposed substrate. Some kelps and other algae growing on exposed surfaces of rocks which have been displaced are now in shaded positions where insufficient light penetrates to support plant life. These algae are dying and will eventually disappear. Likewise, some sessile filter-feeding invertebrates (such as sponges and tunicates) may be eliminated on surfaces where water circulation and food availability have been reduced by displacement.

Because of the extensive fracturing of rock, much new substrate has been exposed. These newly exposed surfaces are already being colonized by mobile invertebrate animals, such as urchins and gastropods and, especially at the shallower locations, by Alaria sp., a common alga. Within several years, these new surfaces probably will be encrusted by organisms and will be indistinguishable from undisturbed areas.

More Surveys

The Auke Bay Laboratory of the National Marine Fisheries Service will make additional underwater surveys at Amchitka in 1972 and 1973 to map the full extent of the disturbed areas and to monitor the reestablishment of marine plants and animals in disturbed areas.

1972 FISH STOCKING IN GREAT LAKES TOTALS 18.5 MILLION

About 18.5 million hatchery-reared fish will be placed into the Great Lakes and their tributary streams in 1972. This will be about a million fewer than the 1970 high, but offers a better balance of species. Atlantic salmon are being introduced; and, for the first time, the release of chinook salmon will surpass coho plantings. This information is provided by the Great Lakes Fishery Commission.

Salmon

Salmon will be released in all Great Lakes and in the waters of all bordering jurisdictions. The 9.7 million smolts or young salmon will include nearly 4.3 million chinook, about 4.1 million coho, over 1.3 million kokanee, and about 39,000 Atlantic salmon. The Atlantics were transported in tank trucks by Michigan and Wisconsin department of natural resources personnel from a hatchery in the Gaspé section of Quebec. Release locations are the Boyne and Au Sable rivers in Michigan, and Pikes Creek at Bayfield, Wisconsin.

Lake Trout

Nearly 5 million lake trout were being planted in lakes Superior and Michigan this spring, the most since 1968. Planting of this species began in 1958 in Superior along with the lampricide treatment of streams where the predator sea lamprey spawn. With 1972's

addition, the 15-year total for Superior will exceed 32 million. Rehabilitation of the lake-trout fishery in Lake Michigan started in 1965, and plantings to date total more than 16 million. The Great Lakes Fishery Commission coordinates this stocking program, which is largely supplied with yearling lake trout from U.S. hatcheries.

Also being planted this spring were 3.8 million other trout--brown, brook, rainbow, steelhead, and splake. Splake is a lake trout-brook trout hybrid; steelhead is the lake-run rainbow trout, which is larger than the stream-dwelling variety.

Lake Michigan

Lake Michigan waters will receive nearly 10.3 million young fish this year--more than half the amount scheduled for release in the Great Lakes. Some 2.9 million lake trout will be put into the waters of the four bordering states by the U.S. Bureau of Sport Fisheries and Wildlife. Michigan's plans to release nearly 5.3 million game fish in Lake Michigan represents about two-thirds the state's 1972 total of about 7.9 million. For Wisconsin, another major contributor, about 1.8 million fish out of this year's $2\frac{1}{2}$-million total release will go into Lake Michigan.

Lake Superior and Huron

Fish stocking for Lake Superior will total 3.3 million; for Huron, 3.4 million. Lake trout is the principal fish going into Superior. The selectively bred splake and splake-lake trout backcross are being used extensively in Lake Huron.

In the eastern Great Lakes, coho and chinook plantings in Lake Erie will total about 300,000, a decline from 1971. However, the Lake Ontario stocking programs of New York and Ontario indicate a two-species total of just over a million, or about double the 1970 figure for that lake.

Huron's Saginaw Bay

About 50 million walleye or yellow pickerel fry were released into the Saginaw Bay section of Lake Huron by Michigan's Department of Natural Resources. The young, quarter-inch fish were provided by New York State's Oneida Lake fish hatchery as part of a reciprocal arrangement under which Michigan has supplied New York with salmon and steelhead eggs. Walleyes are slow growers. It is expected that the legal catch size (13 inches) generally will not be attained in the once-prime Saginaw Bay fishery before 1976.


Rainbow Trout


Chinook Salmon

SCIENTISTS CONTROL REPRODUCTION OF MULLET

The controlled reproduction of mullet, including their spawning out of season, has been achieved by scientists of Hawaii's Oceanic Institute at Waimanalo. These results bring closer the commercial breeding and farming of this widely used oceanic fish. Sea Grant funds supported the research.

The researchers succeeded in spawning the fish in September 1971, five months earlier than their natural spawning season of January or February. They used temperature and photoperiod (light) control. With this, conditions in the holding tank simulated the midwinter season. Also, the females were injected with hormones. Both males and females responded to cool water and short light exposure. Three females were successfully spawned in September. The process was repeated with three other females in October and early November.

Critical Accomplishment

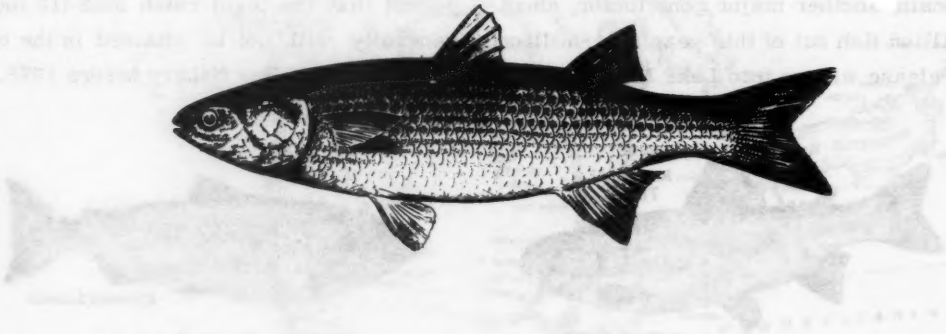
Another important achievement was finding ways to enable the tiny mullet to survive the critical three days after hatching. Immediately after hatching, larvae are nourished by their attached yolk sac. At the end of this stage, about three days, their mouths break through; shortly thereafter, they begin feeding. They sink to bottom of tank. (In the ocean, thermal layers in the water keep them afloat.) Their tender skins break or are bruised by the bottom of the tank, and the injuries lead to infection and mass mortality.

The researchers used an upwelling system in the tanks to prevent larval settling. They achieved survival rates ranging up to 70% instead of the previous 0.5 to 5.0%.

Applicable to Other Fish?

The researchers are refining their techniques. They are examining the possibility of transferring these techniques to other commercially important fish.

They have taken the first steps toward trying to spawn the mahimahi--Hawaiian name for the dolphin or the dorado, an important food fish and luxury item on dinner menus across the Pacific.



FDA SEEKS TO IMPROVE FOOD-PLANT SANITATION

The Food and Drug Administration (FDA) will intensify its regulatory program designed to end insanitary conditions in U.S. food plants. Dr. Charles C. Edwards, Commissioner of Food and Drugs, stated that FDA has devoted most of its inspection resources in recent years to microbiological contamination problems. "It has become apparent, however, that there has been a general decline in the food industries sanitation practices. This has been shown by recent FDA inspections and confirmed by a report of the General Accounting Office which concluded that serious insanitary conditions exist in the food industry."

300 More Inspectors

The proposed 1973 budget for FDA will provide for 300 more food-plant inspectors. They will be able to carry out the sanitation-inspection program without reducing microbiological-contamination inspection.

The Commissioner added: "While we must continue to give high priority attention to microbiological problems such as salmonella and botulism which can present a serious hazard to health, we cannot tolerate a decline in general sanitation practices. We, therefore, intend to take prompt, vigorous action to assure good housekeeping operations, including cleanliness of personnel, equipment, and premises and elimination of all conditions that attract vermin and rodents."

FDA Push Begins

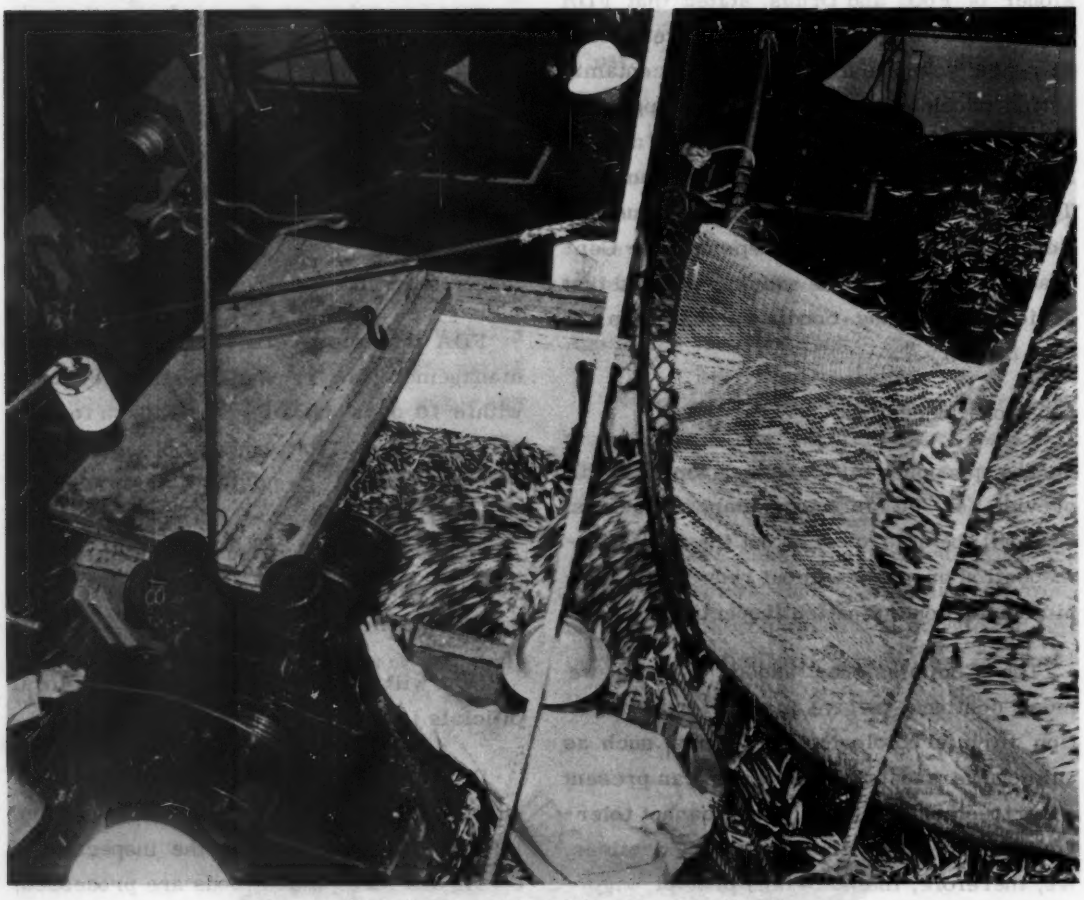
FDA is notifying the food industry through more than 100 trade associations that it is increasing inspection and enforcement actions against sanitary violations. Inspection priority will be given those establishments with a record of deviating from good manufacturing practices.

Inspection Procedure

FDA inspectors will report violations to management and request a written response within 10 days detailing steps taken to correct conditions. The plant will be reinspected within 30 days. Regulatory action will be taken if uncorrected violations are found. Action could include seizure of products, injunction against the plant, or civil or criminal prosecution.

FDA will work closely with State and local officials in all parts of the new program.

Dr. Edwards emphasized that this is not a short-term program but a policy action. Priority will be given to the inspection of conditions under which foods are processed, packed, shipped, and stored. At the same time, the level of inspection of the finished food products will be continued.



Anchovies being emptied into hold of a purse-seine vessel.

SAN PEDRO WETFISH FLEET:
Major Purse-Seine Gear Changes, 1952-1972

Eric H. Knaggs

In 1952, the San Pedro purse-seine fleet consisted of 161 vessels. It dwindled to 42 by 1972. Very few new vessels have been constructed; all but 4 are 23 years old or older.

Although the fleet has decreased, definite improvements have been made in purse-seine gear and techniques.

The two most important changes are the use of nylon netting (replacing cotton netting) and the Puretic power block.

Twenty-eight other changes in equipment represent successful original developments, improvements, or modifications of existing gear.

The first purse-seine vessel to operate at San Pedro, California, was the 'Alpha', which began fishing in 1894. Purse seining proved a very successful way to capture fish. By 1920, the fleet consisted of about 125 purse seiners (Scofield, 1951). The fleet size always fluctuated with economic conditions and availability of wetfish*.

With the collapse of the sardine fishery in the Northwest in the late 1940s, many boats moved into California waters. The later decline in the early 1950s of the California sardine fishery left a sizable fleet of purse seiners (161 vessels in 1952) seeking other wetfish. Some of these vessels turned to salmon or tropical tuna seining, some converted to trawling, while many left the west coast to become property of foreign fishing companies (Perrin and Noetzel, 1969). By 1972, there were only 42 vessels in the wetfish fleet.

Many gear changes have occurred that increased vessel efficiency during this latest period of fleet decline. Some gear adaptations are from the purse-seine revolution that took place in the west coast tuna fishery (McNeely, 1961). Government programs have helped to stimulate fishermen to use new equipment; other gear changes are typical of the ingenuity of individual fishermen.

This article documents major gear changes during the 21 years prior to March 1, 1972. Information on gear improvements is based on personal observations in the San Pedro area and discussions with many fishermen.

PURSE SEINERS IN THE WETFISH FLEET

Thirty-eight of the 42 purse seiners based in the San Pedro area are 23 or more years old. The other seiners are of wood plank construction and range from 44 to 86 feet. Individual load capacities run from 27 to 160 tons. Construction is along the lines of the west coast sardine purse seiner, figure 1

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This study was conducted in cooperation with the Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, under Public Law 88-309, Project 6-3-R.

*Wetfish are species that, when canned, are placed uncooked in the container before being preserved through sterilization by heat. The species canned as such in California are: northern anchovey, Engraulis mordax Girard; Pacific sardine, Sardinops caeruleus (Girard); Pacific mackerel, Scomber japonicus Houttuyn; jack mackerel, Trachurus symmetricus (Ayres); and squid, Loligo opalescens Berry.

Trade names mentioned in this article do not imply endorsement of commercial products.

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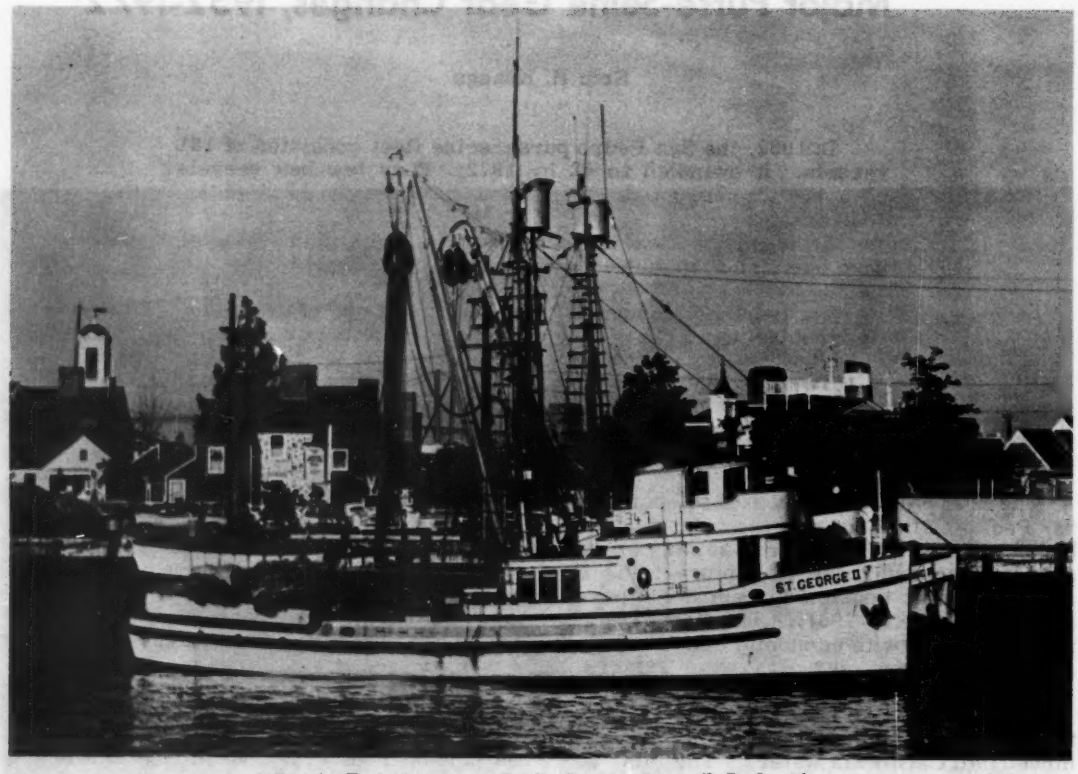

Fig. 1 - Typical west coast "sardine" purse seiner. (J. D. Spratt)

(described by Scofield in 1951 and Daugherty 1952). These vessels have certain common features: a low, flat stern for net storage; one main engine turning a single propeller; a crow's nest on top of a central mast used for fish scouting; a single, large storage area located below ship's deck; and a pursing winch just in front of the hatch.

The 4 newest vessels were built in 1966, 1967, 1969, and 1971. Three of these are steel hulled, while the fourth's hull is fiberglass over plywood.

The 'Veteran' and 'Erm Too' have built-in live-bait wells. These boats have been used very successfully by alternating between live-bait fishing in summer months and mackerel-anchovy fishing in fall and winter months.

The 'Bumble Bee' is the first new boat built since 1949 solely for seining wetfish. It has many features that depart from the typical sardine purse seiner. It has two main engines, the hull is constructed of fiberglass over plywood, refrigeration facilities consist of a spray system and brine tanks, and much equipment is hydraulically run. The vessel has a registered length of 51 feet and carrying capacity of 40 tons. It cruises at 13 to 13.5 knots (3 knots faster than the others) and has a top speed of 18 knots. Bumble Bee has been fished very successfully since its first trip in July 1969.

The 'Teresa T' is a steel-hulled, 50.8-foot (Alaska limit) purse seiner built in 1971. It has a carrying capacity of about 60 tons. The main engine is a Detroit Diesel 12V-71.

The daily load capacity of the San Pedro-based wetfish purse-seine fleet, including old and new vessels, approximates 3,655 tons.

GEAR CHANGES

SYNTHETIC NETTING

DuPont 66 Nylon was first tested experimentally for gill nets in 1939; however, military demand for Nylon during World War II delayed further work in the fishing industry.

The first synthetic fibers to be used by the San Pedro wetfish purse-seine fleet were ropes of Nylon and Dacron. Some difficulty was experienced at first in hanging nets on these ropes. Fishermen learned that synthetic fiber ropes stretch somewhat more than manila ropes, but do not shrink when wet. They modified their hanging techniques to compensate for these differences.

Synthetic polymer netting was first introduced in the 1950s with Marlon in sardine-mackerel seines. Eventually, Nylon replaced all others. In January 1956, the 'Anthony M' carried the first all-Nylon tuna seine (McNeely, 1961); by spring 1959, some boats had tuna or sardine-mackerel purse seines made partly or entirely of Nylon. By 1961, almost all purse seines were made largely or entirely of this fiber. No other type of webbing was being used for repairing nets.

Nylon's Advantages

The advantages of Nylon are: (1) high tensile strength, (2) good elasticity and relatively good recovery, and (3) high resistance to rot and mildew. Formerly, it was necessary to replace half the webbing in a cotton net each year. By comparison, Nylon nets are usually good for 4 or 5 years. In those parts of the net where wear is negligible, Nylon webbing may last 7 or 8 years.

Nylon nets are considerably lighter than cotton nets, and much lighter when compared to wet cotton nets of the same size (approximately half the weight).

To achieve optimum handling characteristics, fishermen dip Nylon purse seines into a stiffening agent, such as an asphalt base tar. It also has been found that a slightly heavier chain lead line must be used to provide desired sinking qualities in the net (National Fisherman, 1957a).

Netting

Standard mesh size for Nylon netting is $1\frac{3}{8}$ inches (stretched mesh) in sardine-mackerel nets, and $\frac{11}{16}$ inch for anchovy nets; some $\frac{5}{8}$- and $\frac{3}{4}$-inch anchovy netting has been used. The larger mesh tuna seine ($4\frac{1}{4}$ inch) has been replaced by sardine-mackerel nets, which also are suitable for taking large pelagic fish. In some cases, boats sew extra pieces of webbing (tuna extensions) on their sardine-mackerel nets for the summer tuna season. This provides the additional length sometimes needed for catching fast-swimming tuna.

Knot slippage or loosening in knotted mesh (Figure 2) was a problem in the early days of synthetic netting. This problem was overcome by using special resin-treated twines and special knots, heat-treating finished nets, and using knotless webbing (Figure 3). Knotless webbing is formed by cords woven together. It is easy to handle, easy to patch, and less likely to chafe. However, knotted webbing is still used in most nets today (1972).

NET AND NET DESIGN

Purse seines, lampara, and ringnets are all classified under the general term of roundhaul net. These nets are all large, encircling nets supported by floats at the water's surface, and weighted by chain or lead at the bottom. The two ends of the net are brought together, the opening at the bottom is at least partially closed to impound a school of fish, and then the net is pulled aboard a boat (Scofield, 1951).

The lampara's essential features are: (1) a large central bag (bunt), (2) wings pulled together, (3) graduated mesh sizes, and (4) no purse line or rings.

The purse seine is characterized by: (1) no bunt, (2) one wing pulled, (3) uniform mesh, and (4) use of the purse line with rings.

The ringnet is a hybrid that started as a modified lampara: (1) the two wings are pulled together, (2) it has purse rings, and (3) little or no bunt.

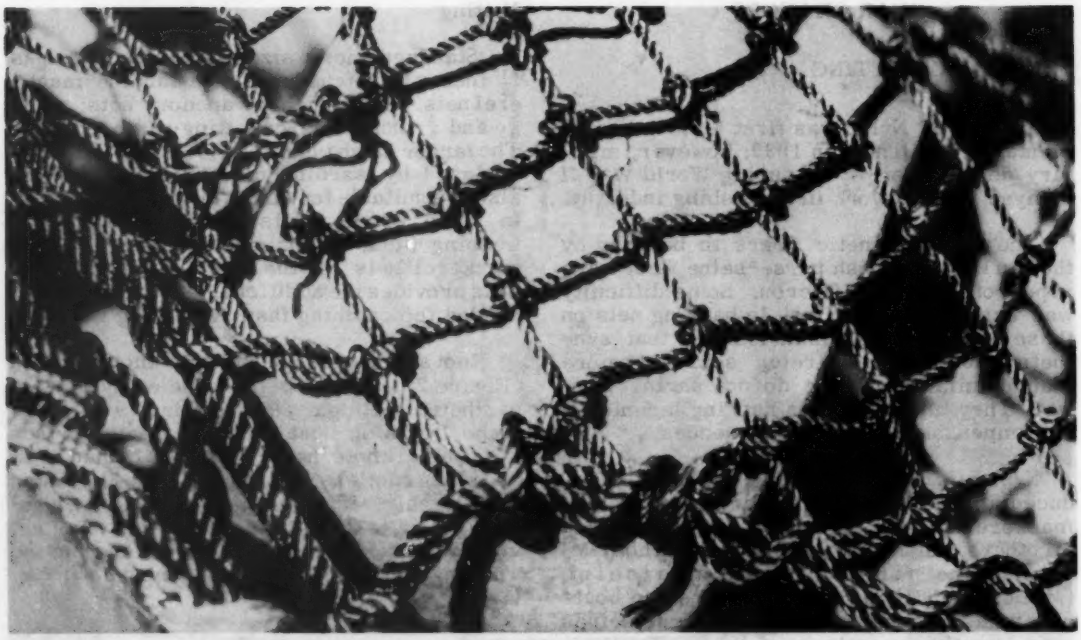

Fig. 2 - Knotted nylon netting.

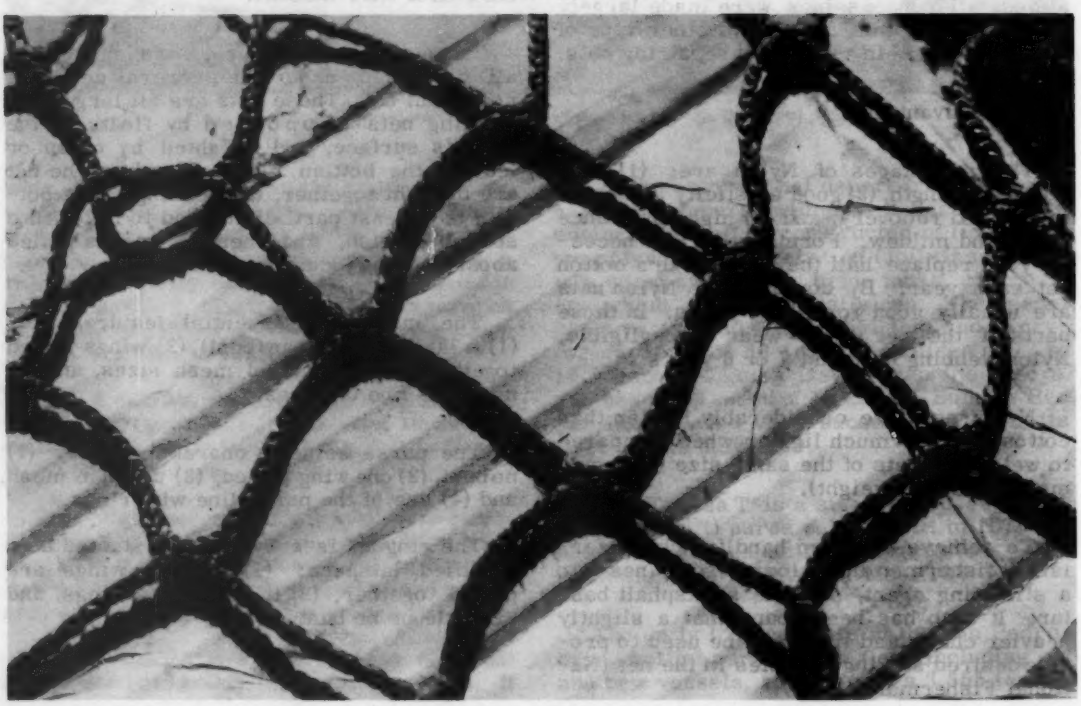

Fig. 3 - Knotless nylon netting. (Photos 2 & 3: Dave Hoopaugh)

Lampara Net Advantages

Each net has been popular with fishermen during various periods of the fishery. Before acceptance of Nylon netting and power block, the lampara net had the advantage of being faster, easier to use, and more efficient than a purse seine; however, with the adoption of these new pieces of equipment, the situation was reversed.

In either the late 1940s or early 1950s, a new-style lampara net, the Porter seine, was developed to catch fish more efficiently under the guidance of an aerial spotter. This adaptation must not have become too popular because it was never mentioned after 1954.

There were still many lampara nets (15) used to fish anchovies in 1966. By early 1967, only four were left; from June 1967 to 1969, only one was used with any regularity. Although lampara nets are no longer used by the wetfish fleet, they still are used by various boats fishing for live bait.

There were never many ringnets used by the wetfish fleet. The last ringnet vanished in 1954 from the San Pedro area.

Each purse-seine net constructed by San Pedro area fishermen has its characteristic design; nevertheless, all are long rectangular walls of webbing. Fishermen are always changing the lengths and depths of their nets. In the early years of the anchovy reduction fishery (1965 and 1966), the average anchovy net was 243 fathoms long by 31 fathoms deep. An average anchovy net in 1972 was 260 fathoms long (range is 190 to 300 fathoms) by 36 fathoms deep (range is 28 to 41 fathoms). An average sardine-mackerel net was 273 fathoms long by 36 fathoms deep.

A modified purse seine, similar to one designed by Ben Yami and Green (1968), was built and used on 'Southern Monarch' by Nick Jurlin in 1969. Basic innovations in this net are longer chain lead line and tapering the net from the center towards the ends. This gives the net a faster sinking rate, and available webbing is used in a more efficient way. This 235 by 31 fathom anchovy net worked very successfully.

PURETIC POWER BLOCK

The first prototype power block was used by Andrew Kuljis on 'Courageous' while fishing for tuna off Mexico in early 1954. Mostly, it was used for small tuna hauls of 10 to 15 tons. The power block kept the net moving and enabled the crew to put the net on the boat faster, thus preventing shark attacks on the catch. By Fall 1960, at least 27 of the 58 large seiners (60 feet or over) fishing for sardines had installed a power block. All purse seiners in the present wetfish fleet are so equipped (Figure 4).

The Puretic power block is an aluminum block with a power-driven sheave. The block is mounted on the boom's tip on most purse seiners.

The first power blocks were powered by the pursing winch. A circular piece of rope, running between a small V sheave on the side of a block and pursing winch, was used as a power belt. Later, a circular piece of $\frac{1}{2}$-inch steel cable was used. After several unsuccessful attempts to mechanize the power block, an integrated hydraulic system was finally perfected. It is the system now in general use. Nevertheless, one boat continues to use the steel cable and pursing winch to rotate the block.

Power Block's Desirable Features

The power block's desirable features are: (1) it reduces manpower requirements; (2) it relieves crew of considerable physical exertion; (3) block can be opened and net placed on the sheave (handy if only half the net is set); and (4) it increases the hauling speed or speed at which a net is put aboard. Vessels utilizing a power block average 25 to 35 minutes in stacking a net; it took 90 minutes with the old method of using a sling and boom hoist.

SPRAY REFRIGERATION SYSTEMS

In recent years (1955-1971), the fleet has seined various pelagic fishes with more regularity and for longer periods. These include jack mackerel, Trachurus symmetricus (Ayres); Pacific bonito, Sarda chiliensis (Cuvier); albacore, Thunnus alalunga (Bonnaterre); bluefin tuna, Thunnus thynnus (Linnaeus); yellowfin tuna, Thunnus albacares

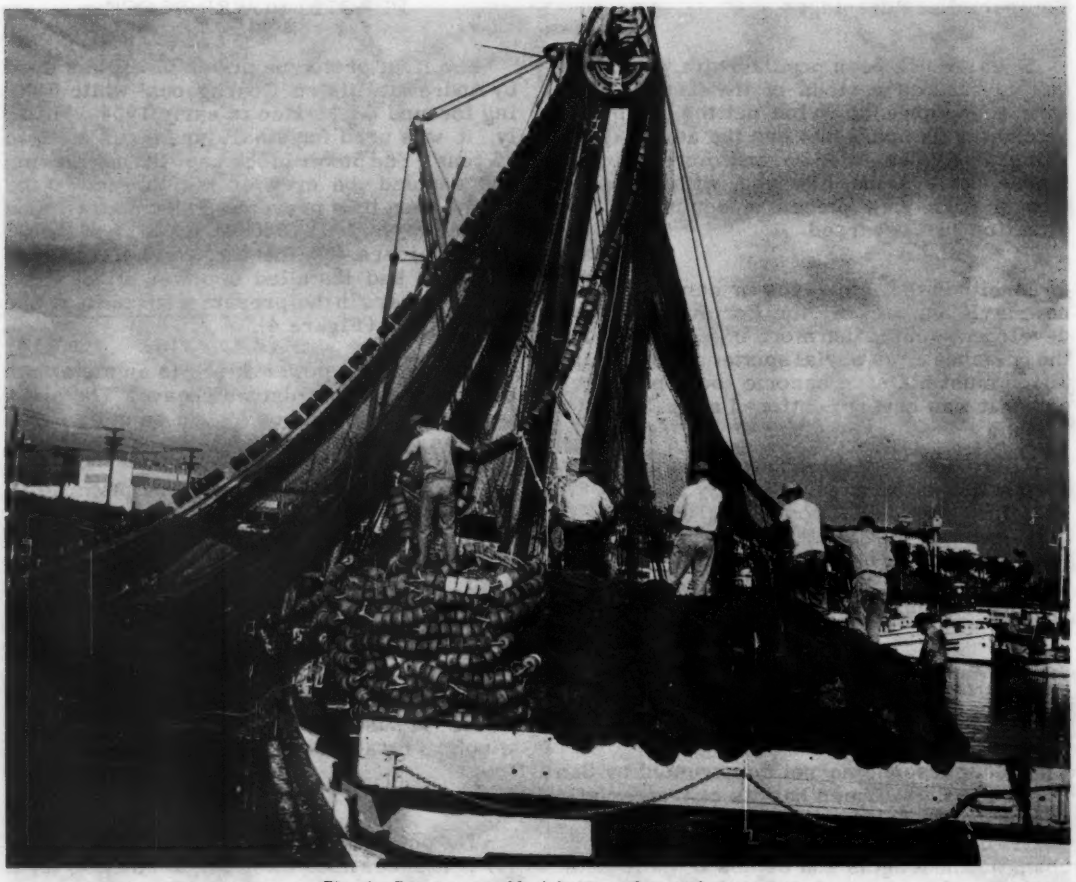

Fig. 4 - Puretic power block being used to stack a net.

(Bonnaterre); and skipjack tuna, Euthynnus pelamis (Linnaeus). It is not unusual for a boat to spend up to 10 days at sea. So spray refrigeration systems have been added to boats' gear.

When purse seiners started making long trips for fish, the boats would be filled with ice. When fish were caught, they were brailed on deck. Then a large part of the crew would go below and break loose the ice carried by the vessel. Then the fish were passed down to the crew. Generally, a layer of fish was stowed and a layer of ice shoveled in on top of them. The process continued until the bin or hold was filled (National Fisherman, 1958a).

Permanent installation of freezing coils in larger tuna purse seiners began about 1945 or before. During 1946, many larger seiners were equipped with refrigeration (Scofield, 1951). This refrigeration coil system did not have the capacity to freeze large amounts of fish without auxiliary ice.

The first spray brine system was used on the 'Jo Ann' in 1957. This system consisted of an ice machine and coils in the ship's hold. Water was circulated and sprayed on refrigeration coils, gradually building up a large mass of ice on them as much as a foot in diameter.

Fish were placed in the hold and brine water released into the compartment. Ice that had built up on the coils would melt, thus cooling the brine water. Then, the brine water was circulated to freeze the fish. Also, more water was sprayed on the coils. This cold

brine dripped on the fish and continued to chill them (National Fisherman, 1958a).

In the early 1960s, Capt. Anthony DiLeva saw a new type of refrigeration system on some visiting Canadian fishing vessels. Aided by Quality Refrigeration Company, Wilmington, California, he modified this new form of spray system and installed it on 'San Antonio IV'. This spray system consists of a refrigeration compressor, an evaporator mounted on deck, and a chiller mounted overhead in the fish hold. The compressor is a Carrier 5H40, driven by a 3-71 GM diesel engine.

The fish hold is lined with fiberglass. Overhead polyvinyl chloride plastic (PVC) spray lines begin at 3 inches in diameter and are gradually reduced to 1 inch to maintain uniform pressure. The actual spray system consists of 13 spray heads and a spray pipe that runs diagonally across the hatch cover. Brine temperature is normally kept at 28 degrees Fahreheit, and the system uses between 1000 and 1200 gallons of sea water.

The spray system operates automatically by means of a control valve built into the compressor. The automatic valve increases or decreases capacity of the system by cutting out one or more cylinders of the 4-cylinder compressor when the desired temperature is reached. Conversely, the valve permits all cylinders to operate when fish are put in the ship's hold (Pacific Fisherman, 1964).

The advantages of this system are: (1) refrigeration of fish is accomplished more efficiently, (2) cooling coils on the bottom of the hold can be eliminated, (3) with the system in operation, the boat can remain at sea until a full load of fish is caught, and (4) this system makes it possible to discharge partial loads when a daily limit is imposed on the vessel.

This newer type of spray system is easily adapted to vessels in the San Pedro wetfish fleet; 11 boats are now so equipped.

FISH PUMP

As early as 1932, attempts were made to use a suction hose to empty the net at sea (Scofield, 1951). In 1955, a suction pump was used on the purse seiner 'Golden West' by John Stanovich (National Fisherman, 1955). The suction pump was 32 inches in diameter, stood 4 feet high, and weighed 700 pounds. This pump sucked 2 tons of water and sardines from the net every minute, rushing the mixture through an 8-inch hose. All these early attempts were impractical or unsuccessful.

In 1968, a commercially built fish pump (Figure 5) and dewatering screen (Figure 6) were installed by John Zankich aboard 'St. Christina' and used successfully in transferring anchovies from net to vessel. This pump was an 8-inch "Capsul-pump" built by Marco of Seattle, Washington. About this same time, the National Marine Fisheries Service (formerly U.S. Bureau of Commercial Fisheries) placed a fish pump aboard 'S.G. Giuseppe' as part of a gear-development program.

The "Capsul-pump" is readily adaptable to purse seiners since it uses hydraulic power that exists already on most boats. Advantages of this lightweight compact pump include: (1) fish transfer from net to boat can begin sooner, (2) "drying up" time is reduced, (3) strain on nets and gear are reduced, and (4) there is less labor involved in handling the catch.

The older method of transferring fish from net to boat is the "stocking" brail (Figure 7). This cumbersome method involves 5 or 6 men who can transfer 1 to 3 tons of fish at a time. In comparison, the fish pump requires only 2 or 3 men and is faster.

Lack of acceptance of the "Capsul-pump" by most fishermen is due to three factors: (1) to most fishermen, the "stocking" brail has proved successful in transferring all types of pelagic fish, (2) transfer of fish can be accomplished in reasonable time by the "stocking" brail even though it is slower, and (3) the pump hasn't been used successfully in transferring pelagic fishes larger than anchovies and mackerel.

At the present time, there are 7 fish pumps on the purse seiners. There is only one 8-inch model, while the rest are 10- or 12-inch models.

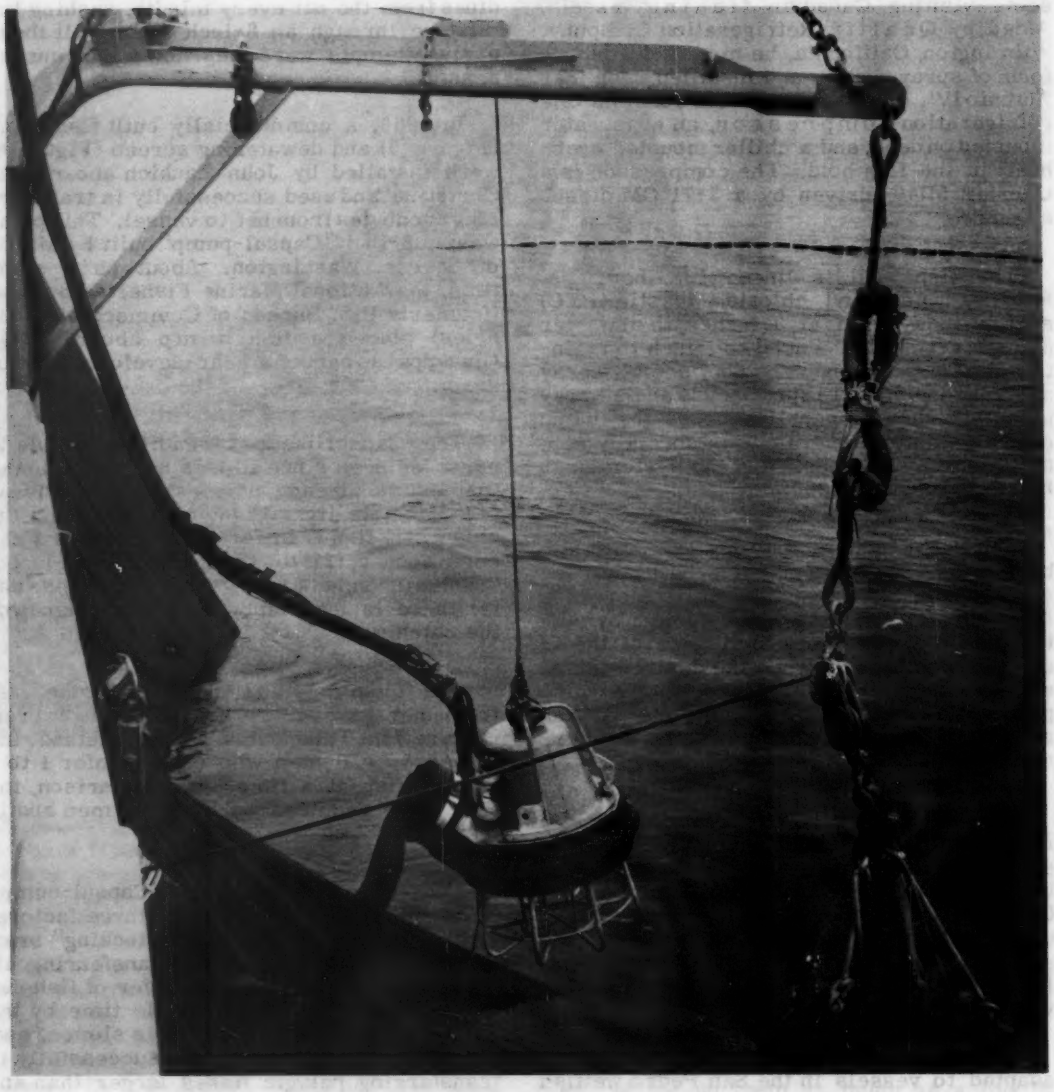

Fig. 5 - Capsul-pump attached to "Morgan" boom.

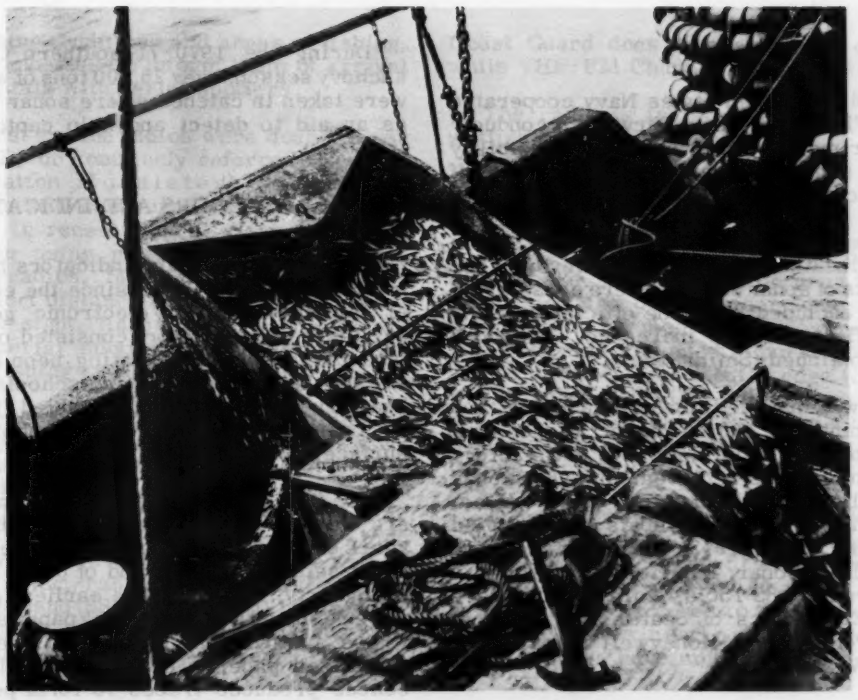

Fig. 6 - Dewatering screen being used on a catch of anchovies. (J. D. Spratt)

Fig. 7 - The stocking brail being used to transfer anchovies from the net to the boat.

SONAR

In 1944, the United States Navy cooperated with the Fish and Wildlife Service in conducting experiments to determine the feasibility of using sonar to locate sardine schools off San Francisco.

The tests demonstrated that fish schools could be located with sonar. However, when all aspects of sonar scouting were considered, it was concluded that the efficiency of the sardine fleet was not increased. The work was discontinued (Smith, 1947).

Sonar was installed aboard 'Sea Pride' and 'West Point' in 1961 (Pacific Fisherman, 1961a); however, it did not prove satisfactory and eventually was removed. In 1969, sonar was installed aboard 'Diana' by Mike Trama; by March 1970, 6 other boats had installed sonar. By March 1972, 15 boats were operating with a sonar. Fourteen of these units were Wesmar SS 150's, built by Western Marine Electronics of Seattle, Washington, while the other was a Honeywell Scanar-11F, Seattle, Washington.

The equipment used is simplified sonar: it is only a scope presentation. The two types of sonar used basically are constructed of two units: a 10-inch display unit, and a transducer. The sonars normally operate on 12, 24, or 32V dc.

The Honeywell Scanar-11F sonar has manual control through 300 degrees, but has automatic sweep through the 180 degrees ahead of the vessel. Also, it can be put on automatic sweep for a selected arc from 30 degrees to 180 degrees. The transducer can be tilted from 10 degrees above horizontal down to 90 degrees. This sonar has a range of 1200 yards and the ranges are marked off on the screen to as close as 40 yards.

The Wesmar SS 150 has a full sweep through 360 degrees. Manual control is available for the whole sweep, or there are a number of programmed search patterns available for varying sectors of the sweep. The transducer can be tilted from 4 degrees above horizontal down to 90 degrees. The range selection is from 100 to 1600 feet.

Fishermen are using sonar very successfully in finding anchovy schools in deep open water. But, in shallow-water areas (under 30 fathoms), the success of finding fish is limited due to bottom interference.

During the 1970-71 southern California anchovy season, over 25,000 tons of anchovies were taken in catches where sonar was used as an aid to detect and help capture these fish.

DEPTH RECORDERS AND INDICATORS

Depth recorders and indicators have been improved in many ways since the early days of finding fish with electronic gear. The earliest depth indicators consisted of a neon-tube display with a rotating neon light that showed the depth on any fish schools between boat and ocean floor. This enabled fishermen to locate schools that did not show on the surface.

The first installations on California seiners were made in late 1944. Within 2 or 3 years of its introduction into the fleet, almost every seiner had some kind of depth indicator (Daugherty, 1952). These earlier indicators were replaced with recording paper sounders, where a moving stylus passed over moving sensitized paper. Electrical impulses from echoes produced traces to form permanent records.

Later, more sophisticated sounders with "white line" presentation for detecting fish within a few feet of the seabed were installed. This new concept was developed because of color tones that can be produced on recording paper are limited and fish images may merge with that of the bottom. To correct this, a gating circuit used for a fraction of a second produces a white line that divides the bottom contour from fish echoes (Haines, 1959). For the San Pedro wetfish fleet, the white-line depth recorder is very useful when fish are deep, over rough irregular bottom, or next to kelp, Macrocystis.

The boats have been equipped with many types of depth recorders and indicators. Some of these depth indicators are still the neon-tube type.

RADIO TELEPHONES

The first reported California trial of a radiotelephone on a fishing boat was in February 1935 on a Monterey purse seiner (Scofield, 1951). The radio telephone was standard equipment in the purse seine fleet by 1940. The two-way communications equipment enabled skippers to inform each other

about fishing conditions and areas of fishing, contact canneries to inform them of arrival time, and talk with aerial spotters.

The first marine radios were double side-band (DSB) or commonly referred to as AM (Amplification Modulated) radio. These radios are still being used on purse seiners; however, in recent years, fishermen also have been using more frequently citizens band (CB) radios. Since citizens band radios are for short distances and generally limited to line of sight, fishermen are able to talk with an aerial spotter or other fishermen close to fishing areas.

The Federal Communications Commission has changed some rules and regulations covering marine communications. A double side-band radio could not be licensed after Jan. 1, 1972, and may not be used at all after Jan. 1, 1977. In its place a very high frequency-modulated (VHF-FM) radio will be used for short-range communications, and single side band (SSB) radios will be used for long-distance transmissions. Citizens band radios may still be used; however, the U.S. Coast Guard does not monitor CB channels, while VHF-FM Channel 16 is monitored.

The radio is indispensable every day to wetfish-fleet fishermen.

NET SKIFF

The net skiff was first used on one end of the net and served as initial drag in pulling the net off the purse seiner when a set was made around a school of fish (Figure 8). The net skiff also was used in pursing the corks and to hold up the net's outer edge (cork line) when fish were brailed onto the vessel (Figure 9). The skiff developed into a heavy and wide "pumpkin seed" craft (Scofield, 1951); the early models had no motors.

The first seiners to have skiffs with motors were 'Ronnie M' and 'Delores M' in 1944. By winter 1950-51, motorized skiffs were observed on at least 46 of the 232 seiners delivering sardines to the Port Hueneme or Los Angeles regions. At present, all purse seiners have motorized skiffs.

Fig. 8 - Net skiff being used at the start of a set.

Fig. 9 - Net skiff holding up outer edge of net.

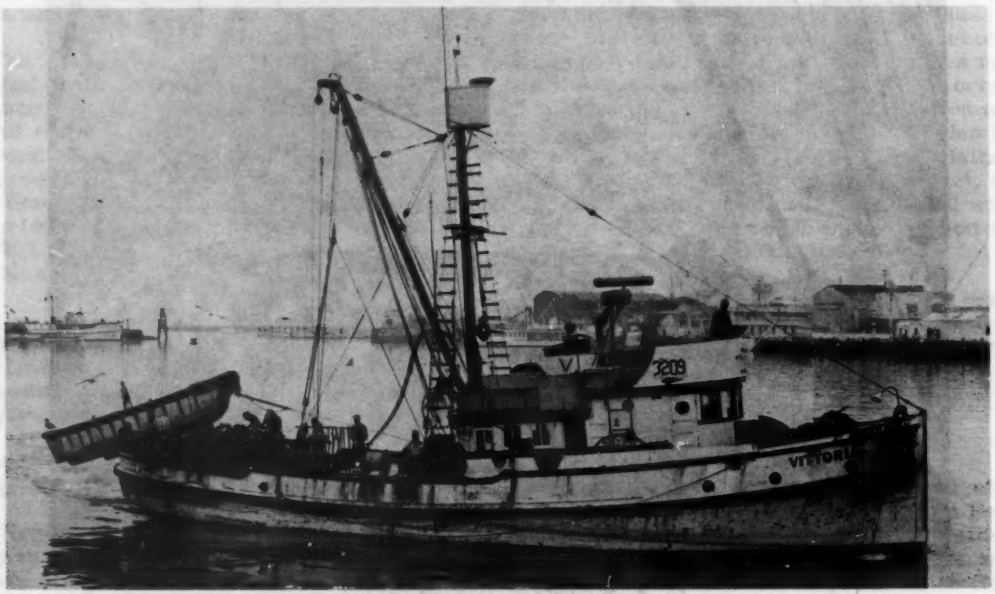

Fig. 10 - Skiff being carried piggyback.

There are two types of skiff engines. The first is a gasoline or diesel inboard engine. A good example is Detroit Diesel Model 2-71 or 3-71. The other type is an outboard motor. Outboards generally range from 35 to 50 horsepower and propel the skiffs on smaller purse seiners.

PIGGYBACKING

A recent development is piggybacking the net skiff. This feature was first used on the west coast tuna seiner 'American Beauty' in 1961 (Pacific Fisherman, 1961b).

Before piggybacking, the skiff was carried atop the net when the vessel was cruising and towed astern when scouting for fish. When the skiff was being towed, it slowed the vessel when speed was essential.

In piggybacking, the skiff is carried on the stern of the purse seiner at such an angle (Figure 10) that if falls directly into the water when a set is made. When the vessel is cruising or scouting for fish, the skiff is held by a cable attached to the pursing winch. The cable is held by a pelican hook, and when a set is made a hammer is used to strike the retaining ring, the pelican hook opens, and the skiff drops into the water.

Since its introduction, piggybacking the net skiff has been widely accepted. There are only two boats that do not have their skiffs riding piggyback.

BALLAST BARRELS

Ballast barrels are 55-gallon oil drums carried in the net skiff. When a large school of fish is netted, the drums are hung outside the skiff and immediately filled with water to stabilize it. This keeps the skiff from tipping over when large amounts of fish sink in the net. Most seiners use one or two ballast barrels in their net skiff.

RADAR

In 1951, only 3 seiners were equipped with radar; the rest did not have great interest in it (Daugherty, 1952). In 1972, only 5 boats are not equipped with radar. Fishermen have purchased radars, not for navigation purposes, but for determining fishing zones open to them during the anchovy reduction season.

CORKS

The first corks were Spanish or Portuguese corks. A later invention was "black cork," which was a cork, tar, and carbon mixture. In the 1950s, synthetic corks first appeared on nets. Spongex corks made by B. F. Goodrich became standard on purse seines. These corks are lightweight, tough, resist crumbling, and absorb little or no water. The plastic reinforcing grommet in the middle of the cork was a later development. This prevents the rope from wearing through the cork.

STEEL CABLE PURSE LINE

Jack Berntsen on the 'Mabel' was first to use steel cable as a purse line in 1927 (Scofield, 1951, Daugherty, 1952). Today, all purse seiners, except one, have steel-cable purse lines.

Most purse cables are spliced together in 3 sections; the center section is constructed of heavier wire. The purse line is commonly $\frac{9}{16}$-inch wire with a $\frac{5}{8}$-inch center piece. The purse cable is $\frac{7}{16}$-inch on smaller seines.

The pursing gypsies on the seine winch had to be enlarged when steel cable was used (Figure 11). The gypsies were surfaced with hardened steel and water cooled to retard wear caused by the steel cable (Philips, 1971).

Steel-cable purse lines couldn't be coiled, so a hand-cranked spool was added to the gear. The purse line was stored on this spool as it was wound off the gypsy.

AERIAL SCOUTING

The first aerial-scouting trials were conducted at San Diego in about 1918. Extensive trials were made in Washington, Oregon, and California from 1930 to 1938, but results were discouraging.

In 1946, aerial spotters were scouting for fish during daylight hours in the Port Hueneme-Santa Barbara area. There were 8

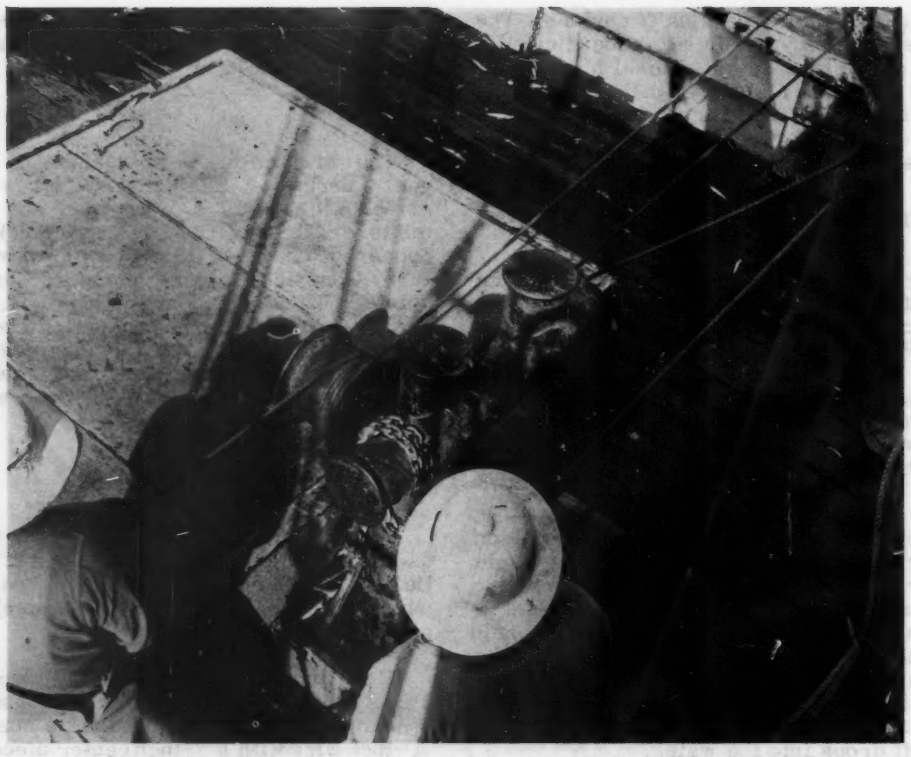

Fig. 11 - Steel-cable purse line wound around the gypsy while the net is being pursed.

aerial observers operating in southern California by 1954 (National Fisherman, 1957b). Aerial spotters were not only locating schools of fish, but guiding boats in a set. Sardine schools were visible from altitudes of 500 to 1000 feet. In 1956, 3 planes were operating out of San Pedro. Pilots worked on a share basis of 5% of the gross catch. These aerial spotters worked day and night hours.

Plane spotters were independent contractors hired by the vessels (National Fisherman, 1958b). They received 7.5% of the gross from catches the vessel made as a direct result of the spotter setting them on fish; otherwise, they received 5% of the gross of all fish taken by the boat, whether or not the aerial spotter was responsible for the catch.

In 1958, there were 8 pilots operating out of San Pedro; during the sardine season, as many as 15 spotters flew. The planes were Pipers or Cessnas equipped with 2-way radio. Aerial spotters operated day or night, up to 16 hours a day. Plane operations generally ranged from Point Conception to San Diego, and covered all islands and fishing banks as far as 90 miles offshore.

Now 6 airplane spotters scout for the San Pedro wetfish fleet. All planes are land based and have a single engine and flying time of over 15 hours. The only modification of the planes is the addition of "crop-dusting tanks" for extra fuel capacity. The aerial spotter receives 5% of the gross from catches the vessel makes as a result of his setting the vessel on the fish, or if he just finds an area of fish and the fishermen catch the fish themselves.

Airplanes are a great advantage in scouting for fish. They cover a greater ocean area and have a much better vantage point in locating fish schools and guiding the direction of a set.

During the 1970-71 anchovy season, aerial spotters helped detect and guide fishermen aboard 13 boats in capturing over 30,000 tons of anchovies.

HYDRAULIC CHOKER WINCH

The hydraulic choker winch is another piece of equipment first used by tuna purse seiners in the late 1950s. Before its invention, the net had to be strapped aboard--using the boat's boom and pursing winch--after the power block had been used to pull in most of the net. Then the net was raised out of the water and on to the boat's deck in sections. This process was repeated until fish in the net were concentrated enough to be brailed. If the catch was large, this process was repeated several times until all fish were brailed aboard.

Choker winches make it easier and faster to bring the net aboard. The most noticeable difference is during brailing. Instead of everybody stopping work to strap net aboard, the choker winch is engaged, which pulls more of the net aboard, and brailing continues.

The winch consists of a drive motor, worm gear, and line spool. While several commercial models are available, some boat owners either have made their own or have had them made locally.

SNAP RINGS

Pietro Maiorana first used snap rings on the 'Diana' in the Monterey area. The snap ring (Figures 12 and 13) is a purse ring with a snap fastener. It is made from hard steel, which is galvanized, and has a safe working load of 2,000 pounds. The working parts are stainless steel to prevent corrosion (Pacific Fisherman, 1959).

The old-type purse rings had to be hoisted on deck after net was pursed and before they could be taken off purse line (Figure 14). This could be extremely dangerous in rough weather.

The newer snap rings are left at the side of the boat after the net is pursed, and the lead line stays in the water. A fisherman then unsnaps the rings from the purse line as

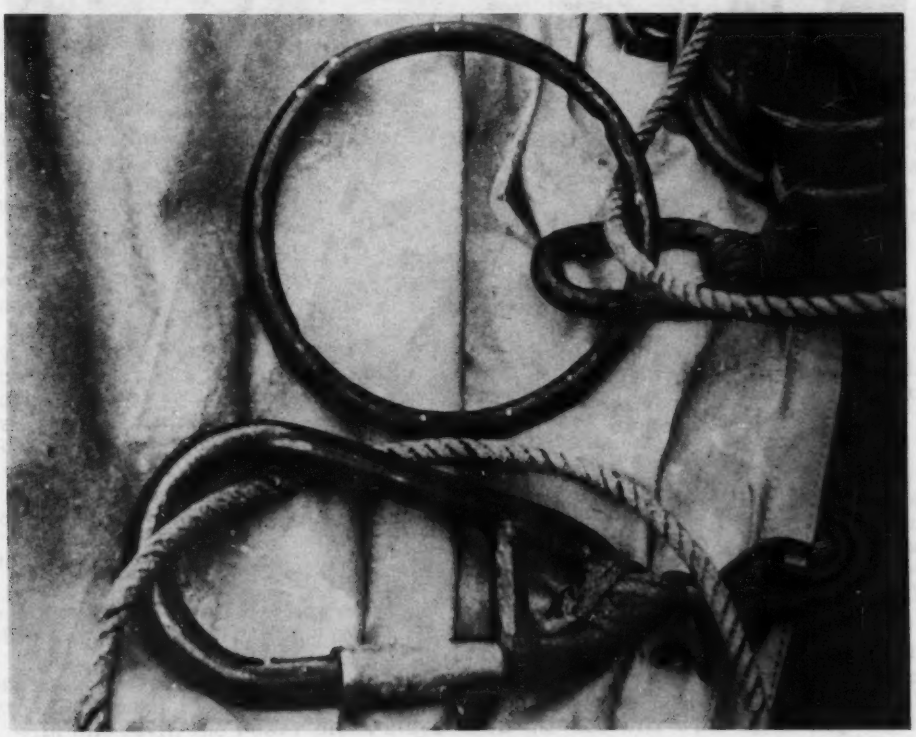

Fig. 12 - Older type purse ring (top) and snap ring (bottom).

Fig. 13 - Snap ring in open position.

Fig. 14 - Purse rings being hoisted on deck.

the net is being put on board. The snap ring not only makes handling the net safer, it cuts handling time by about 30% (Pacific Fisherman, 1959).

AUTOMATIC DIRECTION FINDER

An automatic direction finder (ADF) is a radio-receiving device for determining direction of incoming radio waves. It was first used in the wetfish fleet around 1958. ADF is used for taking bearings on spotter aircraft or on other vessels. Although receivers can be set for several broadcasting bands, purse-seine fishermen generally use citizens band radios during fishing. Because of the limited broadcast range of these radios, ADF has been less effective in finding other boats.

There are presently two models of automatic direction finders used on the boats. One is Bendix ADF 100, the other is Raytheon 358A.

AUTOMATIC PILOT

Automatic pilots are self-regulating mechanisms used in steering the boat. It keeps the purse seiner on a predetermined course in most sea conditions--and saves the man on watch from having to tend the ship's wheel constantly. Most boats are equipped with models of automatic pilots made by Wood Freeman.

RING STACKER

The ring stacker is a horizontal bar used to carry purse rings on small seiners. It is built on the port rail opposite the net.

Larger seiners hang their purse rings over the port rail. If the purse rings were carried in a similar manner on smaller seiners, the rings would either hang in the water or near it. The boat's roll and motion would cause water to sweep and tangle the purse rings. To prevent this, purse rings are stowed on the ring stacker.

KINGPOST

The kingpost is a power-block-carrying davit placed several feet astern the mast and near the starboard side of a purse seiner. The first kingpost was used aboard 'Diana' by Pietro Maiorana (Pacific Fisherman, 1959). With this davit, the power block stays at the top of the boom and doesn't have to be raised and lowered during or after a set has been made. It is a safety factor and eliminates hazards of a wide-swinging boom. The net is a little more difficult to stack when using a kingpost. Six boats have used the kingpost, but fishermen have converted 5 of these back to using a boom to carry the power block. The one exception is 'Erm Too', which still uses a kingpost; this has been moved to the center of the deck behind the hatches. This modification makes the net extremely easy to handle.

DRUM SEINE

Nick Kelly developed the drum seine right after World War II. A large part of handling previously done by crewmen is done automatically with the reel. The net can be set and retrieved more quickly than a regular purse seine. These two advantages make the drum seine ideal for "scratch" fishing where many sets are required to produce a profitable catch (Philips, 1971).

The system consists of a hydraulically driven drum that extends across the vessel's stern. The drum rotates in both forward or reverse for setting or retrieving the net.

The net is retrieved over the stern through a level wind which moves back and forth across the deck on a track. The level wind consists of two parallel upright rollers that are tipped down when the net is set. A free-wheeling mechanism allows the drum to run free when the net is being set, and a brake is used to control the drum to prevent backlashes.

A ring stripper is an accessory piece of equipment used with the drum seine (Figure 15). This steel rod holds all purse rings. It allows the purse line to run freely through them while feeding off one ring at a time as net is retrieved (Hester, Aasted, and Green, 1972).

The 'Sunset', captained by Nick Jurlin and David Masura, was equipped with a drum seine in 1970 (Figure 16). The drum is 14 feet wide with an 8-foot diameter. The drum costs about $17,000, complete with motor and hydraulic equipment (Bunker, 1971; Hester, and Green, 1972).

A purse seine used with a net drum is similar to a regular purse seine, except the cork line and lead line are of equal length so the net will wind up evenly on the reel. The net used on 'Sunset' is 290 fathoms long by 42 fathoms deep.

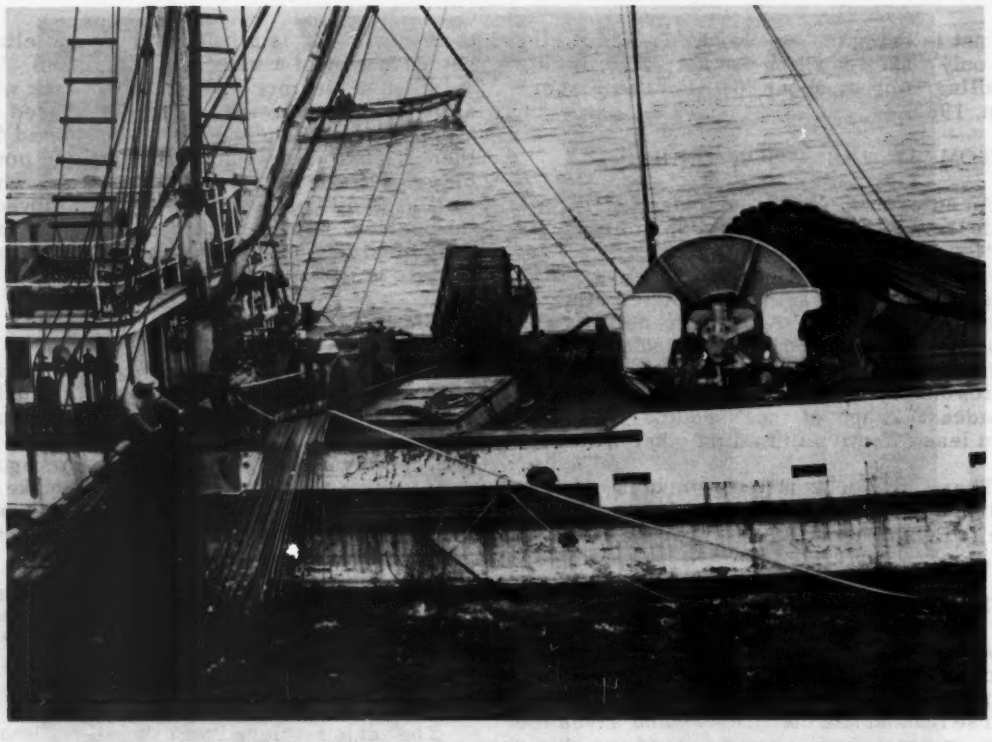

Fig. 15 - Purse rings on ring stripper while net is being retrieved on the drum.

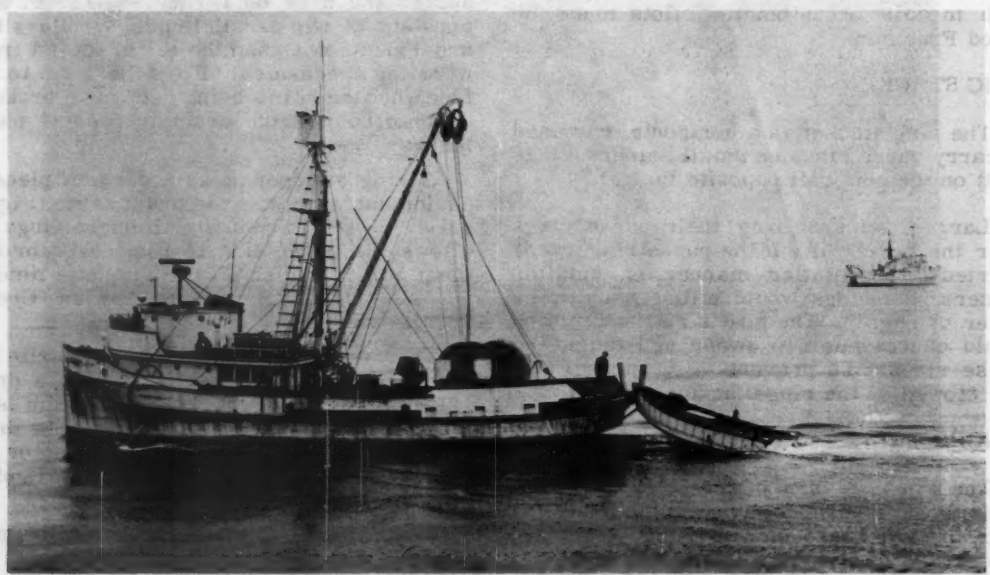

Fig. 16 - The 'Sunset' with a drum seine. (Photos 15 & 16: Roger Green, NMFS)

Drum seining may be one of the least exploited of modern seining techniques. It was obscured before it reached its full development by the Puretic power block. Most wetfish fishermen are impressed by the drum seine's operation, but cost, agreements with local unions, and the impracticability of setting the net with rope suspenders are some present disadvantages.

TURNTABLE

The turntable is a platform on the vessel's stern upon which the net is stacked. The table can be rotated, which permits easier net stacking (Scofield, 1951). In recent years, the turntable has been removed from all but 3 boats; only on one is the turntable operational.

This was a very practical piece of equipment when nets were being strapped aboard before the invention of the Peurtic power block. There was less need for a turntable when fishermen adopted the power block to retrieve their nets.

A net stacked on a boat without a turntable is twisted a half turn as it is rolled through the power block. This twist makes stacking the net a little more difficult; nevertheless, stacking is safer because fish caught in the net more often fall directly to the deck rather than on crew members.

OUTRIGGER POLE

The outrigger pole or "stick" is used when large concentrations of fish are caught. Its main function is to give fish in the net more room to swim by keeping the net away form the boat. This reduces the chance of the cork line being pulled under by fish sounding--and ripping the net or escaping over the sunken cork line. The stick is used rarely today because the power block has reduced the time needed to complete a set. The time fish are crowded at the brailing strip of a purse seine is shortened. Nylon netting also plays a role since it is stronger than cotton netting and less likely to rip if fish sound.

BOOMS

A new concept of the "stick" is the cargo boom and the "Morgan" boom. These are accessory booms in addition to the main boom. These booms, especially the "Morgan", are becoming popular with fishermen using fish pumps. These two booms are used when the catch is "dried up." The cork line of the brailing strip is attached to the boom, which frees the skiff from the "drying up" process and brailing function. This permits the skiff to continue to keep the net free from the purse seiner.

The "Morgan" boom (Figure 5) is a right-angle steel boom mounted on the port rail. It is equipped with a hydraulic ram to keep it in place or pull it in out of the way. Frank Iacono first thought of and installed the "Morgan" boom aboard 'Frankie Boy II'. It works extremely well and many of the vessels with fish pumps are installing it.

CORK PURSE LINE

The cork purse line is a rope strung through a series of small rings along the cork line (Figure 17). It is used to group the corks so there is more support in those areas where a large catch is apt to sink part of the net. The cork purse line has been modified: reduced in length to about 20 to 40 fathoms, compared to old cork purse lines that practically encompassed the entire net. Although there is little need for a cork purse line when catching Pacific mackerel, there is a definite need for it when catching larger pelagic fishes, such as tuna and bonito.

NEW ZIPPER

The zipper is a rope running through a vertical series of rings extending the depth of a purse seine net (Daugherty, 1952). It is used to divide ("cut") the net into smaller parts when a large school of fish has been captured. This division reduces the strain placed on the net by a large catch.

Japanese seine fishermen, working out of San Pedro, developed the net zipper concept in the early 1930s (Scofield, 1951); by 1950, many nets were equipped with zippers. At present, either the zipper has been completely removed or, in a few cases, a narrow strip of large webbing is sewn into a net. This large webbing not only stops tears, but provides a handy marker if the net is divided by hand. Experienced fishermen can divide a wetfish net by hand merely by following the mesh vertically in a straight line.

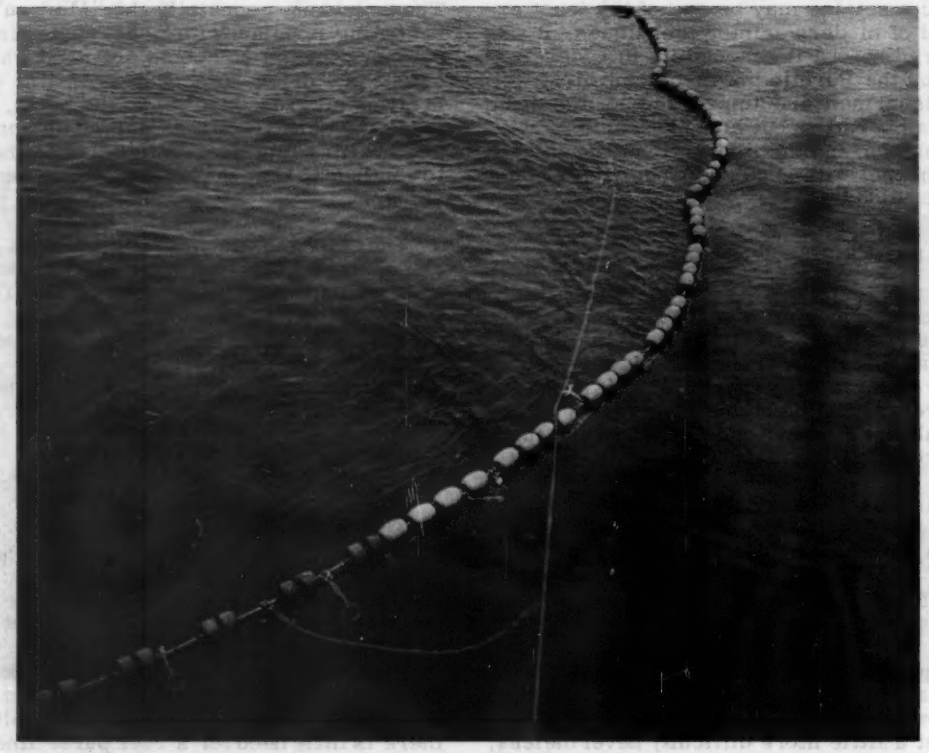

Fig. 17 - Cork purse line.

ROPE SUSPENDERS

The first rope suspenders were used by Tony Mihovilovic on 'Marauder' in November 1956 off Santa Barbara Island.

A rope suspender is a rope run from the cork line in a vertical direction down to the chain lead line. This keeps the net from sinking to its normal fishing depth, and keeps it from snagging on a rough rocky bottom. Several areas where rope suspenders are used are Cortes Bank, when fishing for jack mackerel, and Clarion Island for tuna.

A typical suspender is 17 to 20 fathoms long and can be adjusted to a shorter length. The lines are spaced 15 to 20 fathoms apart along the net. The purse seine tends to sag between suspenders; therefore, 2 to 7 fathoms are allowed for clearance to keep the net off the bottom.

Rope suspenders work very well in combination with a dragger winch. When the net is set, tension is kept on the purse cable and the net can be fished in very shallow water (6-7 fathoms). Rope suspenders have been used for a number of years, but it wasn't until recently that they have been used with any regularity. Most of sardine-mackerel nets are equipped with rope suspenders, while suspenders are not used on anchovy nets.

FLOATING LIGHTS

In 1948 and 1949, high skiffs were used by small boats fishing off San Pedro to attract sardines and live bait (Young, 1950). Small quantities of fish are still caught using this method at various times of the year, but only live-bait lampara fishermen use light skiffs with any regularity at present.

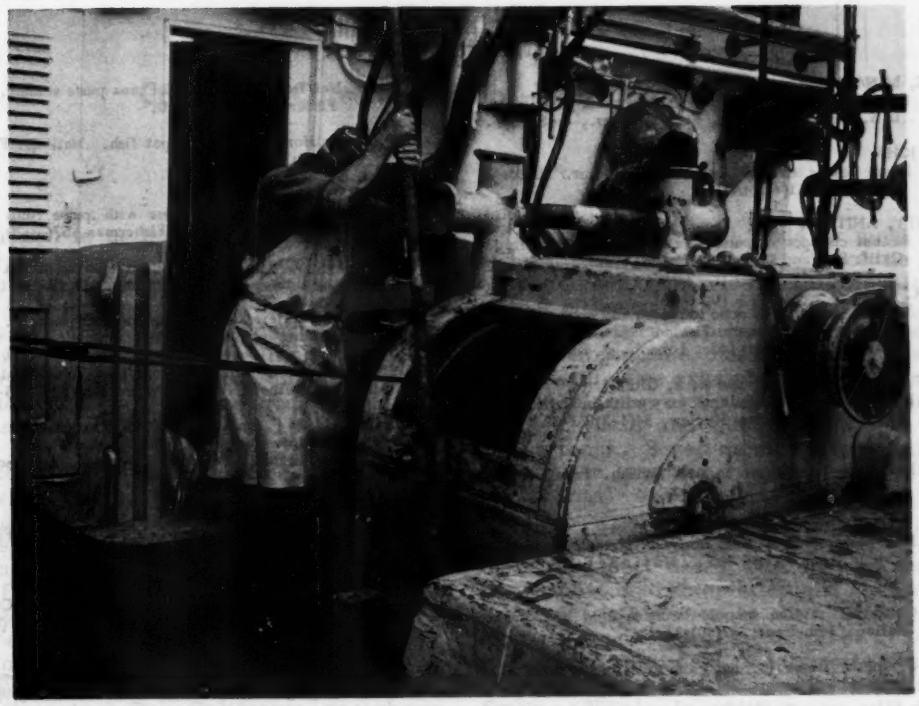

Fig. 18 - Modified dragger winch being used to purse the net.

TRAWL WINCHES

Trawl winches or dragger winches have been modified for seining by being fitted with three drums: two for the purse line and one for the tow line. The 'Fisher Lassie' was equipped with this type of winch in 1944 (Daugherty, 1952). The dragger winch (Figure 18) winds up and holds the purse cable, thereby eliminating hand cranked deck drums. The dragger winch has the advantage, over the standard seine winch, of being able to handle a purse cable with a heavier center piece and there is less tendency for the purse cable to kink. Only nine boats are equipped with modified dragger winches.

SUMMARY

Boats in the San Pedro wetfish fleet range from less than 1 year to 42 years old, with all but four 23 year old or older. All boats have certain common features: a crow's nest on top of a central mast for fish scouting, some form of pursing winch, a low flat stern for net storage, and a relatively large storage area for the catch.

The 'Bumble Bee' is the only boat with many features that depart from the typical sardine purse seiner. This new boat has two engines instead of the usual one. It cruises at 13 to 13.5 knots, 3 knots faster than the others, and has a top speed of 18 knots.

Certainly the two most important gear changes have been adoption of Nylon netting and the Puretic power block. These, along with the other gear changes, have enabled fishermen to remain in business and adjust to the varying availability of several pelagic fishes being sought and taken by the fleet.

ACKNOWLEDGMENTS

The fishermen were extremely helpful and patient when I was collecting data, and I am deeply grateful to them. I thank Herbert W. Frey for his editorial assistance, and Micaela Wolfe and Gayle Jones for their patience in typing my many and various versions of this paper.

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SEASONAL AND GEOGRAPHIC CHARACTERISTICS OF FISHERY RESOURCES

California Current Region--VIII. Zooplankton

David Kramer and Paul E. Smith

Plankton is defined in most dictionaries simply as the passively floating or weakly swimming animal and plant life of a body of water (zooplankton and phytoplankton, respectively). Such an uninteresting definition in no way acknowledges the important roles of such organisms in the food chains in bodies of water and their tremendous variety in species and morphology.

In the California Current region alone, it has been estimated that, for zooplankton only, there are at least 546 invertebrate species (Isaacs, Fleminger and Miller, 1971) and approximately 1,000 vertebrate species, that is, as fish larvae. Such larvae and, in some instances, their eggs were the bases of the first seven reports in this series (Kramer and Smith, 1970a, b, c, d, 1971a, b, c). The variety of species in this region, just for a part off central Baja California, was shown by Ahlstrom and Thrailkill (1963, Table 5). They listed about 145 invertebrates and 36 vertebrates in only 12 plankton samples. Another example of variety of species found near our survey pattern was reported by McGowan and Fraundorf (1966, Table 7) for a small area southeast of Cabo San Lucas near the northern limits of the zooplankton fauna of the equatorial water mass. This report on zooplankton diversity listed 69 species of invertebrates and 81 species of fish larvae collected in 24 plankton samples.

Zooplankton's Essential Role

Zooplankton is not reported here as a fishery, but in recognition of the essential part its vast community plays in relation to the fish resources. In worldwide fisheries, its supply forms the entire diets of plankton feeders such as anchovies, herrings, pilchards, and menhaden. Certain of its constituents, possibly including some phytoplankton, are essential foods for most stages of larval fish development. One of the greatest phenomena of marine-animal development is that of the growth of baleen whales, which feed exclusively on plankton, sometimes only on the shrimplike plankter "krill", a large euphausiid. One example in particular is the blue whale's growth. At birth, this whale is about 7 m long and 2,000 kg in weight (21-23 ft, 2+ tons). Seven months after birth, it is about 16 m long and weighs 23,000 kg (48-52 ft, 25 tons)--feeding only on krill! (Rice, 1972.)

This report deals with the seasonal and geographic characteristics and variations of zooplankton biomass in the California Current region. Organizations, area of investigation, and treatment of data were presented in the first report of this series (Kramer and Smith, 1970a). In addition, we will discuss the annual cycles (variation) for different parts of the survey area north to south and inshore-offshore.

Data Processing

Our previous descriptions of processing data did not include discussion of the methods used to collect and process plankton. Detailed descriptions of the methods for collecting and processing data in the California Current region were described by Kramer, et al. (in press) and in some detail by Smith (1971).

For the data 1951-60, the following methods were used to collect plankton. Each sample was taken with the standard CalCOFI net constructed of silk mesh (bolting cloth), mouth diameter 1 m, and mesh size approximately 0.55 mm. Occasionally a nylon net of the same mouth opening and mesh size was used. A flow meter in the mouth of the net

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permitted calculation of the amount of water strained. Each tow was made by sinking the net at 50 m per minute to a depth of about 140 m (200 m of wire out, depth permitting) and retrieving it at 20 m per minute while maintaining a wire angle of 45 degrees. The ship's speed during a tow was about 2 knots.

Each sample was preserved in 5% formalin and buffered with sodium borate. The samples were brought back to the laboratory and measured by the displacement method described by Ahlstrom and Thrailkill (1963), or by a method developed by Thrailkill, described by Kramer, et al. (in press). Both methods are accurate to ± 1 ml. Smith (1971) discussed the variations due to shrinkage and interstitial liquid as previously reported by Ahlstrom and Thrailkill (1963). Two volumes, reported as ml/1,000 m^3 water strained, were determined for each sample: first, the total volume and, second, the total volume less large organisms--5 ml or greater--usually jellies or jellylike organisms. (Juvenile and small adult fishes captured by the net are not considered planktonic.) Each sample was than sorted for all fish eggs and larvae. The sorted sample was studied further for selected invertebrates (e.g., Isaacs, et al., 1969, 1971). Also see their Table 1 in each volume, which cites investigators, their publications, and interests.

Our treatment of the data is for zooplankton only in terms of total volumes of all organisms with no separation by constitutents or groups. Isaacs, et al. (1969) reported on the seasonal and annual variability among 17 functional groups of zooplankton for the spring (April cruises) and fall (October cruises) for 1955 through 1959. In 1971, they reported on winter variability for January in 1955 through 1959.

Seasonal and Geographic Distribution

The variations in seasonal and geographic distributions for 1951-60, shown in Figures 1 and 2, are similar even though the diagrams are from two sets of data and are presented in somewhat different ways. Figure 1 shows summaries of plankton volumes only for organisms less than 5 ml, expressed as medians of volumes per 1,000 m^3 of water strained--the medians represent the central values of suites of samples. Figure 2 summarizes plankton volumes only for organisms greater than 5 ml, expressed as percentages of occurrences in plankton hauls. Smith (1971, Figure 2) presented the same data in a figure of relative abundances in an atlas of plankton volumes for every survey conducted by the CalCOFI from 1951 through 1960. The basic data for all surveys, 1951 through 1966, were reported by the Staff, South Pacific Fisheries Investigations (1952, 1953, 1954, 1955, 1956) and Thrailkill (1957, 1959, 1961, 1963, 1969, MS).

Each figure indicates the trends to be expected during a year's production of plankton, wherein peaks of abundance occur from spring to summer and decreases occur in fall and winter. (Data were insufficient for summaries to be made for August, September, and November.)

Temperature and Zooplankton

Temperatures at 10 m, summarized for the 10 years in the same pooled areas (Figure 3)--see Kramer and Smith, 1970a, Figure 2--indicate the trends of centers of greatest plankton abundance within a particular range of low temperatures, 12°-15° C. (The 10-m depth is regarded as mid-depth or average of stratum between surface and thermocline. Ten-meter temperatures have been published in atlases for 1949 through 1969 for all CalCOFI surveys (Anonymous, 1963; Wyllie and Lynn, 1971).)

Zooplankton production in "warm" and "cold" years bear out the trends to be expected from the data depicted in Figures 1, 2, and 3. Reid (1962, Figure 5) showed that for each year, 1949 through 1960, plankton volumes were high with low temperatures and low with high temperatures. He also depicted two figures from Thrailkill (1959, 1961) showing averages of high volumes in 1956, a cold year, and low volumes in 1958, a warm year. Ahlstrom and Thrailkill (1963) cited the warm year 1959 and the fact that plankton volumes then were the lowest in a decade.

Annual Cycles

Another illustration of seasonal and geographic changes is in the summarization of data to show annual cycles by region and pooled area (Figure 4). Here, monthly median volumes are presented for six regions, north to south, at 40-mile intervals onshore-offshore. Each curve is an annual cycle beginning in each January (J), summarized over the 10 years, 1951-60. Each

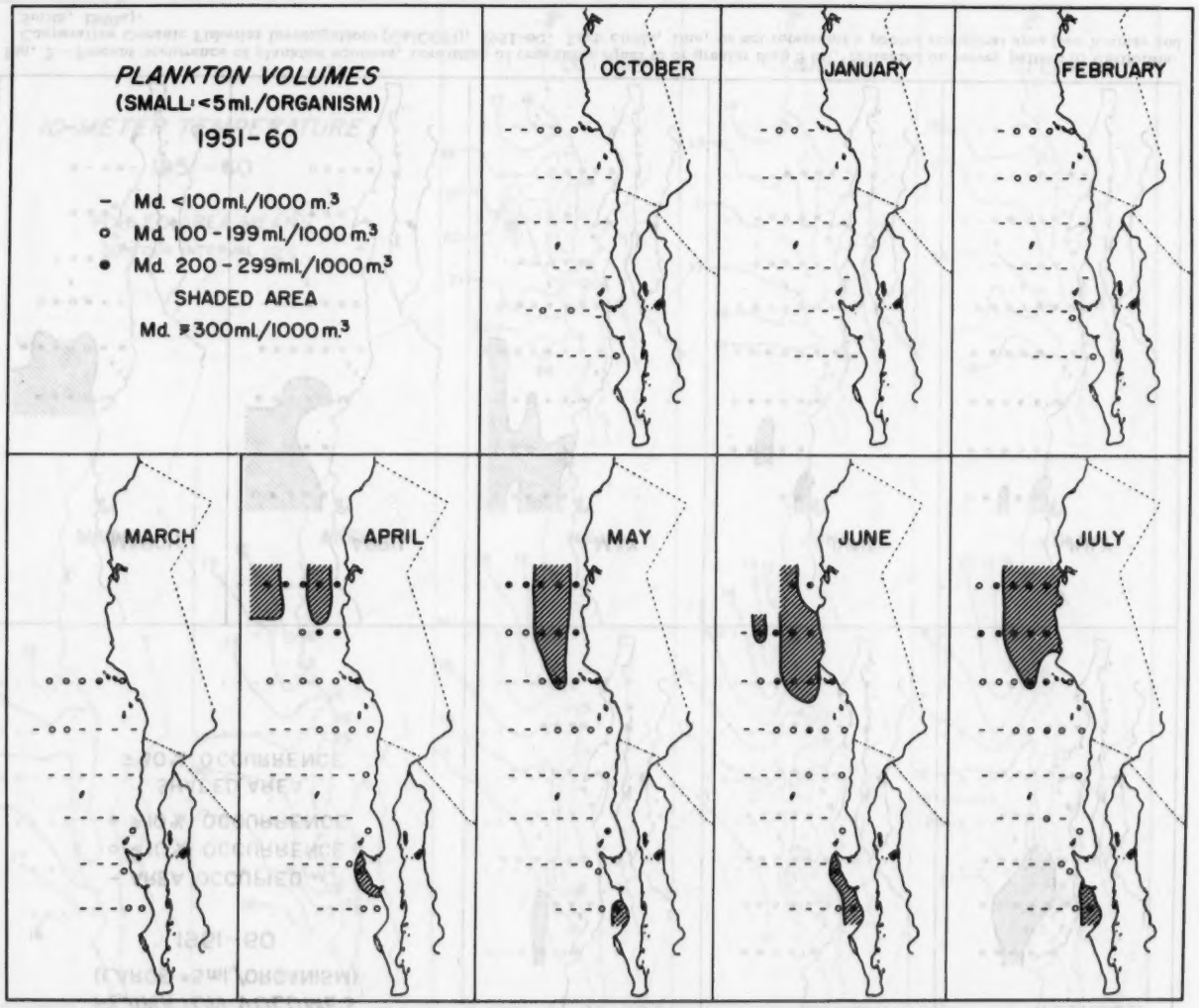

Fig. 1 - Medians of plankton volumes consisting of organisms less than 5 ml collected on survey pattern of California Cooperative Oceanic Fisheries Investigations (CalCOFI), 1951-60. Each circle, line, or dot represents a pooled statistical area (see Kramer and Smith, 1970a).

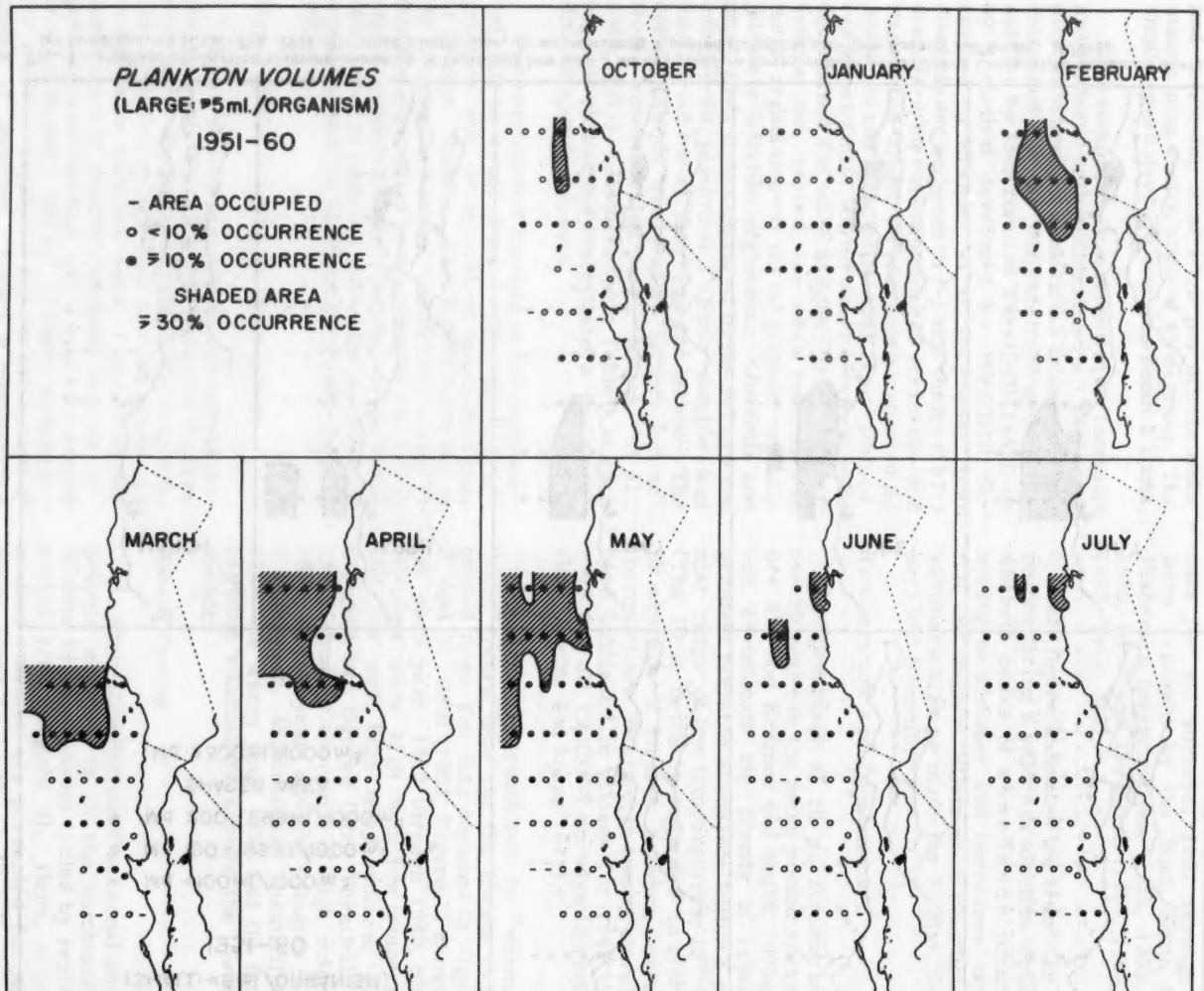

Fig. 2 - Percent occurrence of plankton volumes, consisting of organisms equal to or greater than 5 ml, collected on survey pattern of California Cooperative Oceanic Fisheries Investigations (CalCOFI), 1951-60. Each circle, line, or dot represents a pooled statistical area (see Kramer and Smith, 1950a).

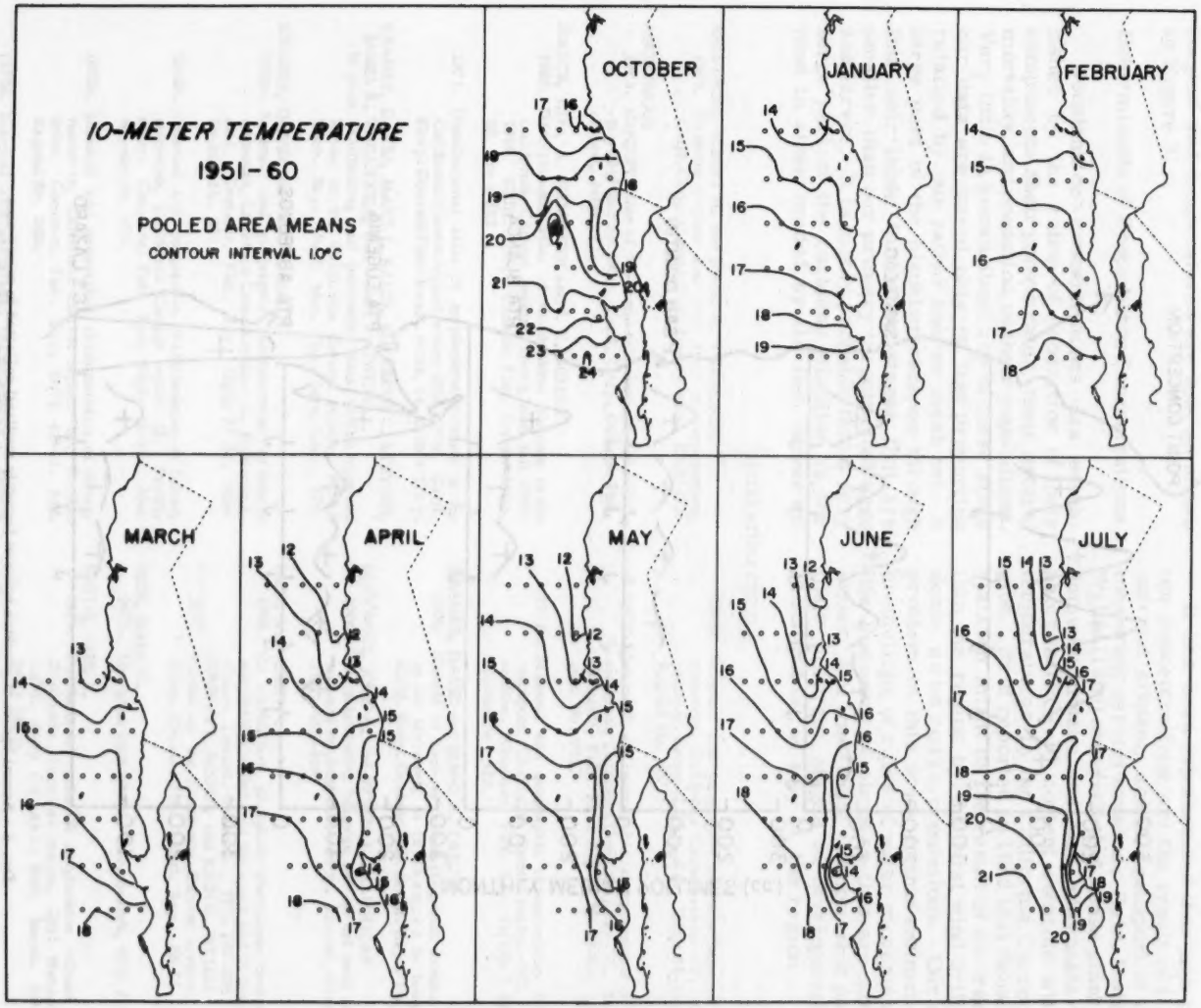

Fig. 3 - Pooled area means of 10-m temperatures in survey pattern of California Cooperative Oceanic Fisheries Investigations (CalCOFI), 1951-60. Each circle, line, or dot represents a pooled statistical area (see Kramer and Smith, 1970a).

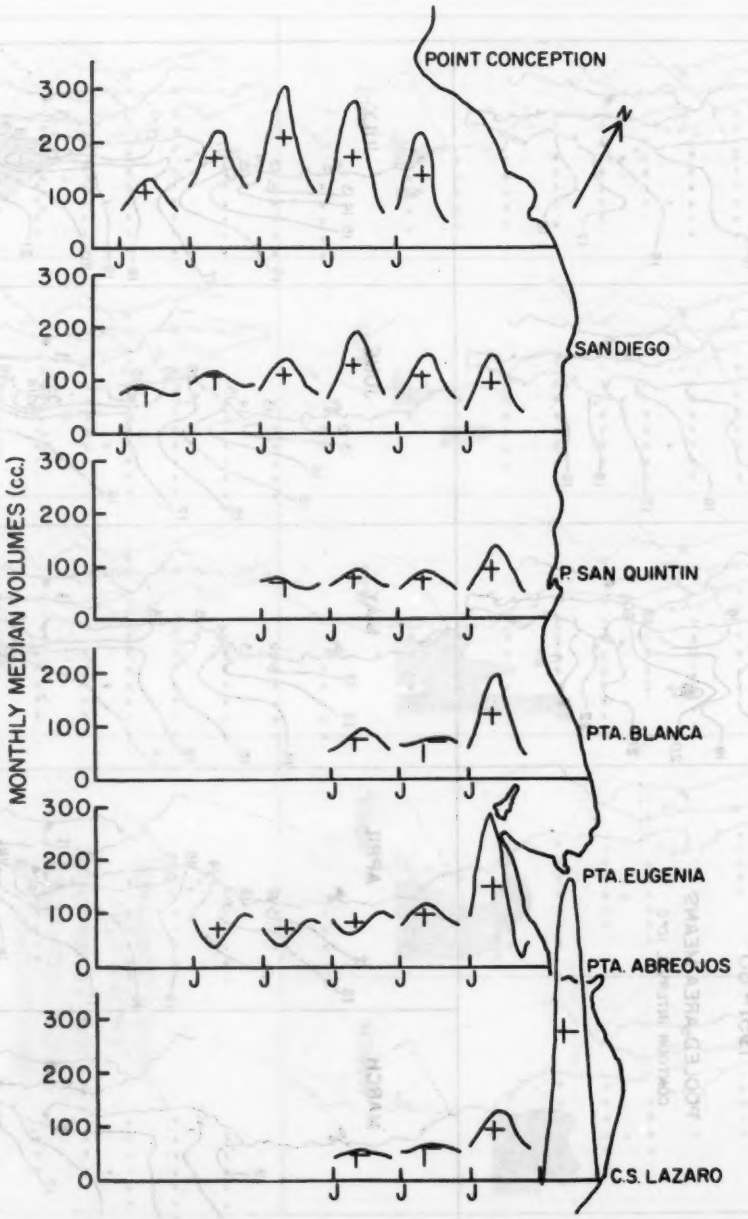

Fig. 4 - Annual cycles of plankton volumes (monthly medians) collected in survey area of California Cooperative Oceanic Fisheries Investigations (CalCOFI), 1951-60. (See text.) There are no curves shown for offshore areas, Punta San Quintin, and south because there were no significant annual cycles in monthly median volumes in those regions.

vertical line in each curve represents June and each horizontal line is the annual average. Here, as in Figures 1 and 2, high abundance occurs in mid-year when day length is longest and temperatures are low, as shown in Figure 3.

Determinants of Zooplankton Concentrations

Zooplankton concentrations are established by the rates of production of their components, their growth rates, their natural mortality, and predation on their populations. Very little is known about any of these since our data are based only on that proportion retained by our rather coarse-mesh net. A large part of the plankton escapes through this net--those immature stages that are smaller than our primary targets, fish eggs and larvae. It is highly probable that a very large part of the escaping plankton is the food in sizes needed by the fish larvae we collect--for example, as listed for anchovy larvae by Kramer and Zweifel (1970, Table 2).

It has been hypothesized that high plankton concentrations are the result of (1) high nutrient content, and (2) transport of plankton during certain seasons. Reid, Roden and Wyllie (1958) observed that dense plankton in summer months and high phosphate-phosphorous (PO_4-P) content coincide with low temperatures in the California Current region. Reid reported in 1962 that dense zooplankton might be the result of its transport into the region by the west wind drift from dense subarctic populations. Our major problem in this study is that estimates and predictions of rates of water movement, and life histories of plankton that are not well known, are inadequate to show what parts in their different stages of development drift in and out of, or stay in, the region.

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OYSTERS: Reattachment As Method of Rearing Cultchless Hatchery Oysters

John G. Riley, Richard J. Rowe, Herbert Hidu

Cultchless European oysters, Ostrea edulis, were artificially reattached to asbestos-cement boards. After 4 months' submersion, the oysters showed growth rates and morphology superior to those of nearby tray-grown stocks; they demonstrated natural reattachment to the panels. Experiments were conducted to identify a suitable gluing technique to take advantage of this phenomenon and to investigate the potential for reattachment as a field-rearing technique.

The most significant development in oyster hatchery economics in recent years has been cultchless setting (Pacific Mariculture 1967, Long Island Oyster Farms 1970, Anon. 1969). Great efficiency is achieved in the juvenile phase by eliminating bulky cultch and oyster mortality due to crowding loss on cultch. However, the rearing of a free juvenile oyster to harvest has presented the industry with new problems. It may not be practical to place small free oysters directly on the bottom because of high loss due to siltation, movement by currents (MacKenzie 1970), and bottom-dwelling predators, especially blue crabs in the Chesapeake area (Edwin Powell). The traying of cultchless oysters to harvest may present economic problems due to the handling necessary to alleviate crowding and to control fouling organisms.

Rear Cultchless Oysters

An alternate approach is to rear cultchless oysters under controlled conditions to a size allowing efficient growth in the hatchery (approximately $\frac{1}{4}$") and then reattach the oysters to a substrate for placement in the field to harvest. Such a method would permit the efficiency of the hatchery cultchless operation; at the same time, it would allow optimal spatial distribution of oysters later in the field. This may provide conditions for maximum growth and desirable shell dimensions. A rearing system incorporating small flat panels as the substrate for reattachment offers potential for the mechanization of all necessary handling operations.

INITIAL EVALUATION

Experiments were begun in June 1971 to determine the biological response of oysters to reattachment and to identify a suitable artificial substrate and glue. Experimental work in developing and evaluating artificial cultch materials has identified asbestos-cement board as the most widely successful (Marshall 1970). Plastics coated with various materials have been tried as natural set collectors but, as yet, with no marked success. To evaluate asbestos board as a substrate for reattachment, 2' x 1' panels of $\frac{1}{4}$" material were cut. Six-month-old European oysters, Ostrea edulis, were attached at 3" spacings on both sides. Two types of glue were used, a 2-part epoxy compound (Polypoxy Underwater Patching) and a polysulfide-based calking material (Boatlife--Life Calk).

4 Months In Water

The panels were suspended vertically from a raft in a sheltered cove in Maine's Damariscotta River in June 1971. After 4 months in the water, they were removed for examination. A large proportion of the reattached oysters had fallen off. This indicated that the method of attachment was as yet unsatisfactory. The fault probably lay in insufficient drying time allowed for the glues before submersion. However, those that remained attached showed a very favorable response in several aspects. The reattached oysters responded to the substrate by depositing the new shell of the left valve in close

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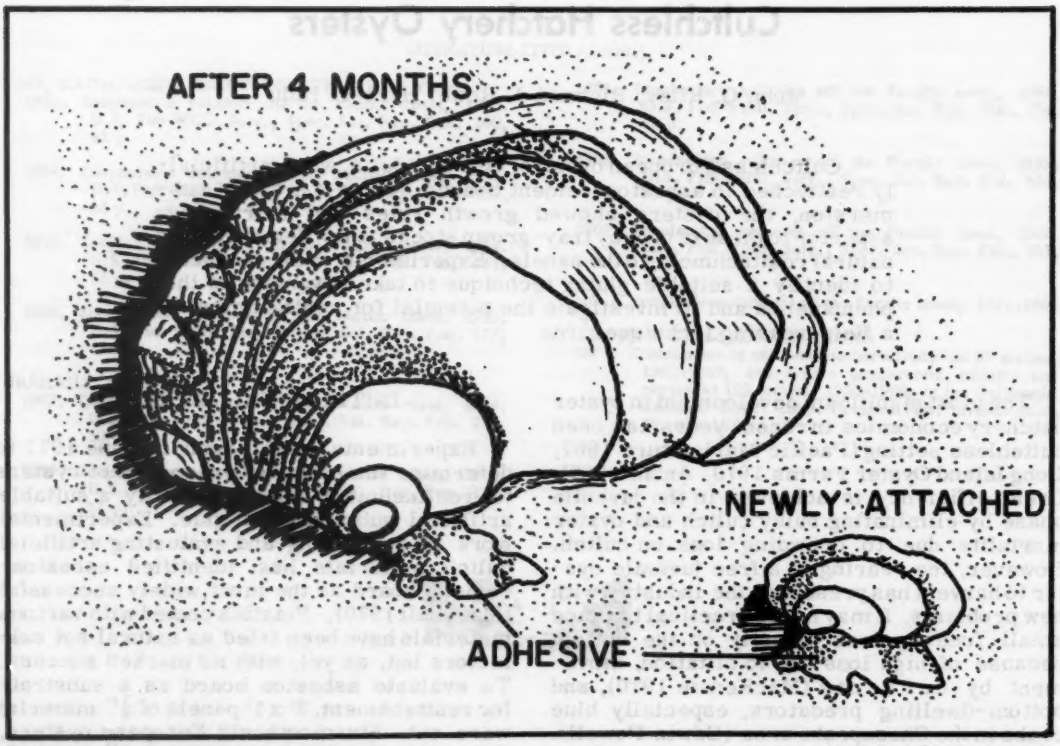

Growth response of the European oyster when attached to asbestos cement-board panel. New shell growth of the left value is tightly adhered to the flat surface around most of its margin.

proximity to the substrate. The result was that a very permanent new adhesive was formed that probably would be able to support the oyster in position to a harvestable size (Figure).

The oysters' growth rate exceeded rate of oysters in the laboratory or in nearby screened cages. Moreover, the attached oysters maintained a more symmetrical shell morphology. This has bearing on the ultimate sale price.

DEVELOPMENT OF GLUING TECHNIQUE

Despite the high losses due to falling off in the initial tests, the results were encouring. A second pilot experiment was performed tofind a suitable adhesive and method of applying it. In addition to the original twoglues, we used a fiberglas resin (Valspar Super Iso-Resin) and a portland-cement-based waterproof patcher (Quick Plug, Reardon Co., Toms River, N.J. 08753). The adhesives were made up according to directions. The juvenile oysters were attached simply by putting spots of glue at 4" centers on each panel, and pressing the shell into the glue.

Variables other than different glues were investigated: (1) attachment by upper (right) valve or lower (left) valve, (2) drying oysters before gluing versus gluing wet, and (3) curing time for glue before submersion. After appropriate drying times, the panels were hung from raft as in first experiment.

Comparative Values of Glues

After two months in the water, the panels were removed and examined for loss through falling off and mortality of the reattached oysters. The fiberglas resin formed the strongest bond. However, it required that the oysters be dry before gluing; also, it necessitated several hours' curing time before submersion. A further fault lay in the

fact that it was simple, using this low-viscocity resin, to glue together inadvertently the two valves of the oyster--thereby preventing opening. The Polypoxy Resin and the Life Calk gave a high incidence of falling off and proved messy to apply. The portland-cement Quick Plug yielded the best overall results. Besides giving zero mortality and zero loss due to falling off, it was nontoxic and took minimal drying time.

Using Portland Cement

Using the portland cement, juvenile oysters may be taken out of the water, glued in place on a panel, and the panel submerged immediately. It was not the strongest glue tested, but it is doubtful that any artificial glue used on the small oysters could maintain support for the 2 to 3 years necessary to harvest. All that is required is positioning of the juvenile until natural reattachment occurs--1 to 2 weeks under favorable growing conditions. Concerning orientation, during the few months of submersion, it appeared that growth rate and gluing success were equally good, whichever valve was attached; permanent natural reattachment was most apparent where the right valve was uppermost, as in Figure, but further investigation is required into this aspect.

CONCLUSIONS

The initial experiments indicated that reattachment is a technically feasible method, using asbestos-cement board as an artificial substrate, and a quick-drying portland cement as the gluing agent. Reattachment has potential as a means of rearing cultchless hatchery oysters. More extensive work is now in progress to evaluate the system quantitatively on a long-term basis, to determine the optimum spatial arrangement of the oysters on the panels and of the panels themselves, and to compare growth rate and survival to those of conventional rearing methods.

We thank Dwight Worcester and Brian Holmes for their efforts in setting up the initial experiments, and Phyllis Coggins for the illustration.

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SHIPBOARD PROCEDURES TO DECREASE LOBSTER MORTALITY

Ronald Joel Smolowitz

The development of the offshore lobster fishery has created a need to decrease lobster mortality during long periods of storage onboard ship. This paper discusses aspects of the shipboard-storage problem and presents one successful method now in operation.

Reduction in lobster mortality means more lobsters to meet increasing demand. A 1971 market analysis by NMFS economists indicated that industry revenue should increase as production increases, although a temporary decline in prices might occur. Revenue would increase because the increase in quantity would more than offset decrease in price.

The major causes of lobster mortality after capture are:

a) suffocation
b) thermal shock
c) rough handling
d) disease

A review of the cause-and-effect relationships will introduce possible engineering solutions to the problem.

Suffocation Major Death Cause

Suffocation seems to be the major cause of lobster deaths in storage. If water circulation and aeration are not provided, or are not adequate, oxygen deficiency will result. The oxygen problem can be a localized one, such as in tank corners where lobsters tend to congregate. Lobsters require a continuous supply of oxygen to live. Their oxygen demand increases at higher water temperatures and during feeding. For this reason, feeding lobsters in storage is not recommended. Feeding lobsters also results in increased waste products, which make the environment unhealthy and consume the precious oxygen. Cold water not only lowers the lobsters' oxygen demand but increases the oxygen-holding capacity of the tank water.

The most common method of replenishing the supply of oxygen to lobsters in holding tanks is to pump new sea water continually through the tanks. The disadvantages are the need for special equipment to move large amounts of water, and the lack of control over the water temperature.

Water temperature should be held between 45° and 50° F. to minimize thermal shock. Thermal shock can result if lobsters are brought up from the colder bottom depths and stored at much higher water temperatures, or if a sea-water circulation system is used, when passing through warm surface water. The key here is rate of acclimatization. Lobsters can survive in warm water provided it warms gradually. However, cold water is desirable because you can store more lobsters per gallon due to the increased oxygen-holding capacity. Colder water also has the advantage of delaying moulting. Many vessels refrigerate and recirculate sea water in their tanks. Over longer storage periods, though, the oxygen must be replenished.

Successful Storage Method

Massachusetts Marine Biologist John Hughes has developed a successful storage method in cooperation with lobstermen Jack Baker and Jack Marley. Mr. Baker is the owner of two stern trawlers, the 'Shanty Queen' and the 'Shanty Girl', and two seafood restaurants, Baker's Lobster Shanty at Point Pleasant Beach, New Jersey, and Lobster Shanty North, P.E.I., Canada. Mr. Marley manages the operations. Baker's vessels have refrigerated holds containing plywood tanks. The same seawater is used for the entire trip and is aerated continuously by an air-pump system.

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The Hold

It is desirable to refrigerate the hold, which contains the lobster tanks, to maintain air temperatures between 40° and 45° F. Due to the wide variety of vessel and hold configurations, local refrigeration people will have to provide the necessary assistance in choosing the right equipment. A standard freezer-evaporator system, using refrigerator plates or coils, has been found adequate. The hold should be insulated and, possibly, a fan provided to improve air circulation. One refrigeration company familiar with lobster-refrigeration systems suggests foam implaced urethane as a good insulator. The lobsters should not be permitted to come in direct contact with the urethane because they will tear it.

In some installations, of a more permanent nature, it may be desirable to refrigerate the tank water directly. If this is the case, the cooling coils have to be made of, or coated with, a material that is not toxic to lobsters. The lobsters should not be allowed to come in direct contact with the coils. To avoid mass mortality due to a leak in a coil, a secondary coolant might be considered, such as brine, that can be detected by a salinometer before deaths occur. A common system is a separate cooling tank with a circulating water system to the lobster-holding tanks.

If a vessel has a small hold, it might possibly be cheaper to use ice outside the tanks. When using this method, care should be taken to keep ice from entering the tanks because decrease in salinity of tank water could harm the lobsters.

The Tank

Ordinary Marine Grade plywood is good material for tank construction. However, the better exterior grade plywoods can be used with excellent results, especially when coated. Rubber or plastic-based paint should be used on the interior surfaces. The seams of the tanks can be bonded with brushable epoxy glue. Be sure that no copper, lead, or zinc materials are used on the sea-water side of the tanks. Stainless steel or plastic fittings are best because they are nontoxic to lobsters and hold up well in the sea-water environment.

The sizes of the tanks depend on the size and shape of the hold. Too large a tank can cause stability problems in rough weather.

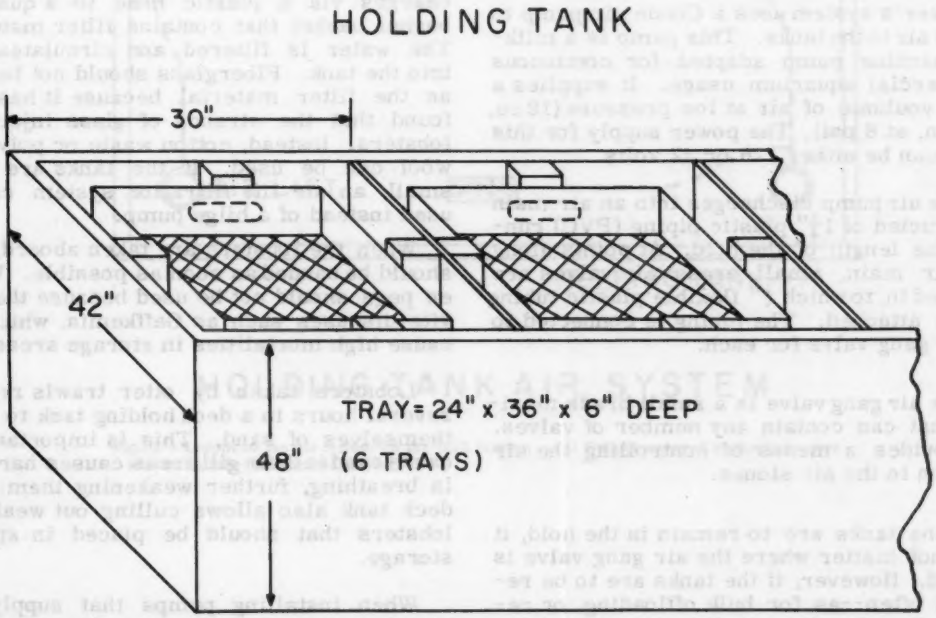


Fig. 1 - Concept for a lobster-holding tank using tray storage. The trays are designed to have positive bouyancy when full, and to sink when the next tray is placed on top.

Surge effects in the tanks can harm lobsters. On Baker's boats, the holds are 18' x 16' x 8' high and contain ten tanks 48" x 32" x 34" deep. Each tank holds 600 pounds of lobsters.

It may be desirable for fast turn-around operations to build smaller tanks that can be hoisted out of the hold. A variation on this might be permanent tanks containing removable trays. This also has the benefit of decreasing the handling of lobsters, which will improve the quality of the landed product. Handling weakens and often injures the lobsters, which are already under stress. Handling also increases the possibility of death from loss of blood, infection, and the effects of overcrowding.

A drain should be located near the bottom of the tank so the tank can be emptied easily in case of emergency or before docking. The drain, like all the sea-water piping, should be either plastic or stainless steel.

The tank should have a removable splash cover. On Baker's vessels, the covers can be hooked onto the overhead and out of the way while work is in progress.

The Air System

Baker's system uses a Conde air pump to supply air to the tanks. This pump is a milking machine pump adapted for continuous commercial aquarium usage. It supplies a large voulume of air at low pressure (18 cu. ft./min. at 8 psi). The power supply for this pump can be either 110 or 32 volts.

The air pump discharges into an air main constructed of $1\frac{1}{2}$" plastic piping (PVC) running the length of the hold. At points along the air main, small brass air valves are screwed in, to which $\frac{1}{4}$" flexible plastic tubing can be attached. The tubing is connected to an air gang valve for each.

The air gang valve is a small brass manifold that can contain any number of valves. It provides a means of controlling the air division to the air stones.

If the tanks are to remain in the hold, it does not matter where the air gang valve is located. However, if the tanks are to be removed often--as for bulk offloading, or removal for cleaning, drying, or repair--the gang valve should be mounted on the tank. In this way, only one air hose has to be disconnected to remove the tank.

Quarter-inch plastic tubing is run from the gang valve outlets to air stones located in three of the tank corners and in the center of each side, all on the tank bottom.

Air Stones Break Air Flow

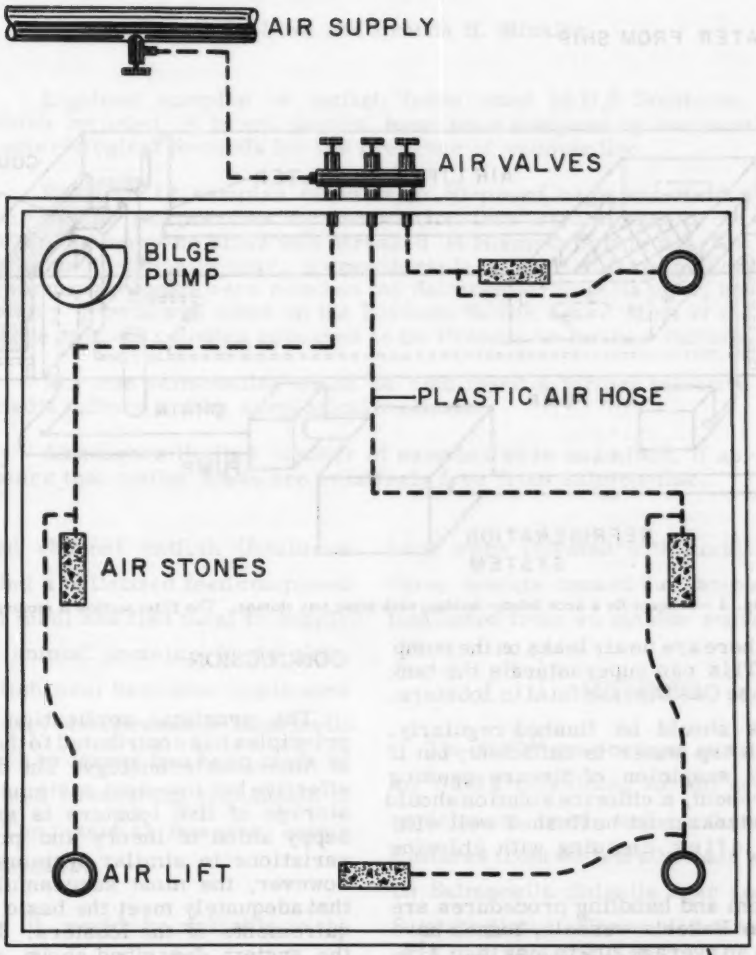
Air stones are devices commonly found in home tropical aquariums that are used to break the air flow into many tiny bubbles. The air stones for the tank corners can be the small round type, those for the sides can be the 12-inch variety. The corner-located air stones should be enclosed in $1\frac{1}{2}$" PVC pipe mounted vertically. This pipe should be located about an inch off the bottom and extend up to within several inches of the water surface. The flow out of the air stone provides an air lift creating an upward flow of water, thus circulating and enriching the water.

Filtration and additional circulation are provided by a small all-plastic bilge pump in the fourth corner of the tank. The pump discharges via a plastic hose to a quarter-bushel basket that contains filter material. The water is filtered and circulates back into the tank. Fiberglass should not be used as the filter material because it has been found that the strands of glass injure the lobsters. Instead, cotton waste or polyester wool can be used. If the tanks are made small, an air lift filtration system can be used instead of a bilge pump.

When the lobsters are taken aboard, they should be banded as soon as possible. Wooden pegs should not be used because they invite diseases such as Gaffkemia, which can cause high mortalities in storage areas.

Lobsters taken by otter trawls require several hours in a deck holding tank to clean themselves of sand. This is important because sand in their gill areas causes hardship in breathing, further weakening them. The deck tank also allows culling out weakened lobsters that should be placed in special storage.

When installing pumps that supply sea water to lobster-storage tanks, be very



HOLDING TANK AIR SYSTEM

Fig. 2 - Layout of the air system on the tank bottom. All fittings exposed to the sea water should be free of toxic materials.

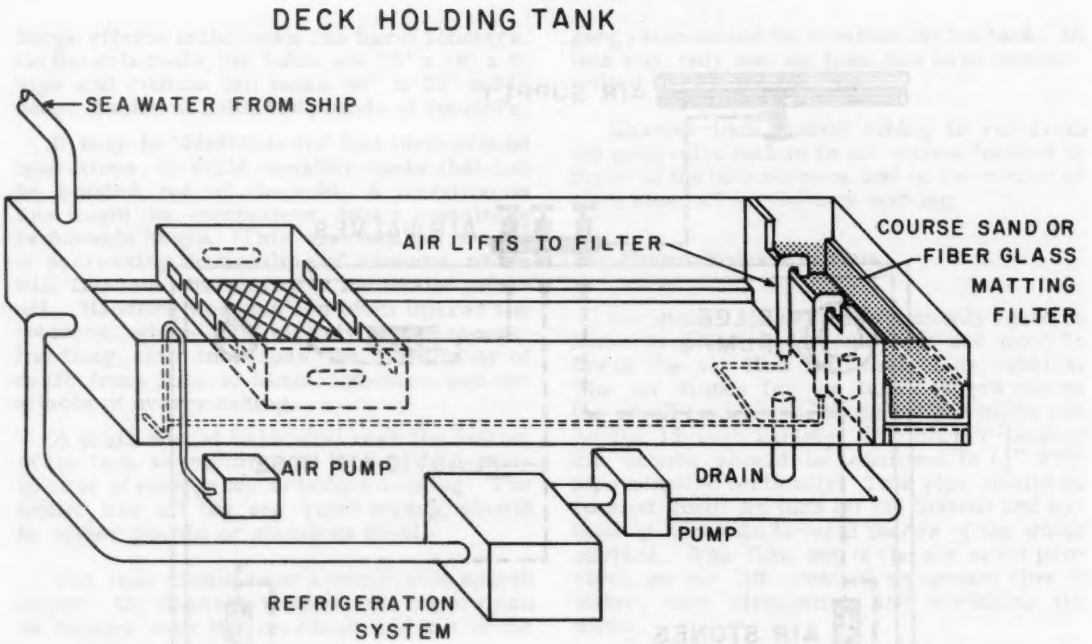


Fig. 3 - Concept for a deck lobster-holding tank using tray storage. The filter section is removable.

careful that there are no air leaks on the pump inlet side. This can supersaturate the tank water and cause Gas Disease fatal to lobsters.

The tanks should be flushed regularly. Usually fresh tap water is sufficient, but if there is any suspicion of disease-causing organisms present, a chlorine solution should be used. The tanks must be flushed well with fresh water after cleaning with chlorine solution.

This system and handling procedures are effective. On Baker's vessels, losses have been cut from an average 20% to less than $2\frac{1}{2}$%. During one summer trip, when surface-water temperatures were in the 70's, they lost only 165 lbs. of 7,300 lbs. landed; 90% of the fatalities were newly shed lobsters.

CONCLUSION

The practical application of scientific principles has contributed to the rapid growth of American technology. The development of effective but low-cost systems for shipboard storage of live lobsters is an example of a happy union of theory and practice. Many variations in similar systems are possible; however, the most successful will be those that adequately meet the basic biological requirements of the lobsters. The success of the system described above reflects its capacity either to compensate for the lobster's needs or to adjust them to fall within the system's capabilities. Either way, the result has been successful.

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STUDIES OF SALMONELLAE POTENTIAL IN CATFISH FEEDS

Travis D. Love and Brenda H. Minkler

Eighteen samples of catfish feeds used in U.S. Southeast, which included 14 brand names, have been analyzed by standard bacteriological methods for the presence of salmonellae.

Each of 18 samples taken from 50-pound bags was divided into six 50-gm portions for inoculation into tetrathionate broth. After 24 hours, the broth was streaked on Bismuth Sulfite agar and Salmonella-Shigella agar. A considerable number of large mucoid swarming colonies were noted on the Salmonella-Shigella agar, but scanty growth was noted on the Bismuth Sulfite agar. Most of the large mucoid colonies appeared to be Proteus on further culture.

Not true salmonellae could be confirmed on further selective media culture and by serological methods.

Although a limited number of samples were examined, it appears that catfish feeds are relatively free from salmonellae.

Farm-raised channel catfish (Ictalurus punctatus) are fed a pelletized feed composed in part of meat meal and fish meal to supply the necessary animal protein. In the past, meat meal and fish meal have been implicated in the epidemiology of outbreaks of Salmonella dysentery. Much progress has been made in the sanitation and processing techniques of these meals. The potential, however, exists for further outbreaks.

We decided it would be valuable to the commercial pond-raised catfish industry to determine the potential for Salmonellae in the dressed fish from pelletized feeds. Eighteen samples, composed of six 50-gm portions, were obtained from 14 different brand names. The samples were obtained by aseptic techniques from 50-pound bags. Two bags were infested with small beetles, and these insects caused the samples to be contaminated from an outside source.

METHODS

The six 50 gm portions were added to 500 ml flasks containing 300 ml of tetrathionate enrichment broth and incubated overnight. Cultures from the tetrathionate were streaked on Salmonella-Shigella agar and on Bismuth Sulphite plates. These plates were incubated 24 hours and any suspicious colonies were inoculated on Triple Sugar Iron slants. Slants showing typical Salmonellae reactions were transferred to Urea broth and Salmonella-Shigella plates. The few positive results from these media were tested by serological methods.

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RESULTS

From the 108 50-gm portions, no positive serological tests were found for Salmonellae. It was noted, however, that considerable "spreading colonies" occurred on the Salmonella-Shigella plates. This was especially notable in those samples containing insects when the entire plate was covered by the "spreader." These "spreaders" gave the typical presumptive tests for Proteus in Urea broth and on the Triple Sugar Iron slants.

CONCLUSIONS

It is not known at this time what effect large numbers of Proteus might have on the keeping quality of fresh dressed iced catfish. Proteus is a hydrogen-sulphide former in most situations. The pond-raised catfish industry is troubled with "off" odors in the live fish, and these odors are carried over to the dressed fish even in the most sanitary conditions.

It has been learned that pelletized catfish feed is often formed by a hot extrusion method in order to obtain the necessary dryness for slow sinking or floating feeds. It appears from this brief study that Salmonellae from commercial catfish feeds will not be a problem in that industry. Further studies already are underway on the musty odor problem at other laboratories.

WHALING OBSERVER PACTS SIGNED

1. JAPAN AND USSR

Japan and the Soviet Union signed an agreement in Moscow on April 18 providing for the placement of observers aboard their whaling vessels. The agreement, first of its kind between whaling nations, resulted from a decision reached at the June 1971 annual meeting of the International Whaling Commission (IWC).

The Agreement

The agreement will be in force until Feb. 28, 1973. Under it, Soviet observers will be assigned to each of the three Japanese whaling fleets that will operate in the North Pacific between mid-May and mid-June. Japanese observers will be assigned to the two Soviet whale fleets that will operate later in the summer. The observers will help determine whether whaling operations are being conducted under the rules of the international convention for the regulation of whaling. They will report their findings to the IWC. ('Tokyo Kyodo', Apr. 19.)

2. JAPAN AND U.S.

On April 26, Japanese Foreign Minister Fukuda and U.S. Ambassador Ingersoll signed an Agreement on the International Observer Scheme for Whaling Operations from Land Stations in the North Pacific. The agreement will remain in effect until Feb. 28, 1973.

Under the agreement, U.S. observers may be stationed at the six Japanese land stations: Wakkanai of Nippon Hogei, Kiritappu and Osawa of Nitto Hogei, Onagawa of Nippon Suisan, Ayukawa of Taiyo Gyogyo, and Ayukawa of Nitto Hogei.

The 1972 North Pacific Coastal Whaling season is from May 1 to October 31 for baleen whales, and from May 1 to December 31 for sperm whales ('Suisan Tsushin', Apr. 27.)

The Japanese quota for 1972 coastal whaling was reduced 20% from 1971 quota.

The Japanese quota for the 21st North Pacific Whaling Season was reduced 20% to 554 BWU.

3. NORTH ATLANTIC

On April 7, 1972, representatives of Norway, Canada, and Iceland signed an agreement to implement an international observer system for North Atlantic coastal (land based) whaling stations. The agreement entered into force on April 14. The three countries were expected to exchange observers during this year's whaling season beginning in May. (U.S. Embassy, Oslo, Apr. 24.)

JAPAN & USSR AGREE ON 1972 SALMON QUOTAS

The 16th annual meeting of the Japan-USSR Fisheries Commission, Moscow, March 1-April 20, culminated in an agreement signed April 21. The high-seas salmon quotas for 1972 are 87,000 metric tons for Japan and 3,000 tons for the Soviet Union.

This year, besides closing designated zones in Area A (north of 45° N. latitude) to Japanese fishing during specified periods, closures were established for the first time in several places in Area B (south of 45° N. latitude). Japan finally accepted this measure only for 1972, a year of poor pink-salmon run.

In the 1972 high-seas salmon fishery, the Soviets are likely to use mothership-type operations for the first time. ('Suisan Tsushin', May 2, 'Nihon Suisan Shimbun', Apr. 24.)

U.S.-BRAZIL AGREE ON SHRIMP FISHING

On May 9, 1972, the U.S. and Brazil signed an agreement establishing a shrimp-conservation zone off Brazil. Within the zone, the activities of shrimp vessels of the two countries will be regulated.

The agreement was signed by U.S. Ambassador William Rountree and Brazil's

Foreign Minister, Mario Gibson Barbosa. It will be submitted to the senate for ratification. A ratified agreement would remain in effect at least until January 1973.

Reserve Juridical Positions

The agreement reflects mutual concern for shrimp conservation. The two parties reserve their juridical positions on territorial seas and fishery jurisdiction under international law.

FAO FERRO-CEMENT FISHING VESSEL SEMINAR IN NEW ZEALAND

A 5-day seminar on the design and construction of ferro-cement fishing vessels will be held by FAO in Wellington, New Zealand, beginning Oct. 9, 1972.

The seminar, hosted by New Zealand, is being held in response to growing interest in developed and developing countries in the use of these vessels. Participants will be from FAO's Indo-Pacific Fisheries Council (IPFC)--largely the developing countries along the Indian and Pacific Oceans--and from the Netherlands, United Kingdom, U.S., and others.

Main Purpose

The seminar's main purpose is to collect all data on existing ferro-cement boats, especially on construction methods, costs, and operational experience. The properties of ferro-cement as a boatbuilding material will be discussed and compared with other materials, modern and traditional.

FAO provided technical aid in building a 16-meter trawler in Thailand, an 11-meter gillnetter/handliner in Dahomey, and two open boats (7.5 and 10 meters) in Italy for Egypt. Also, three ferro-cement trawlers are being constructed for use in FAO projects in Uganda, Dahomey, and Madagascar.

Address questions about seminar to: Secretary, Seminar on the Design and Construction of Ferro-Cement Fishing Vessels, Department of Fisheries, FAO, Rome 00100, Italy.

NORWEGIAN FISHERIES FAIR, AUGUST 14-20

The Fourth Norwegian Fisheries Fair will take place in Trondheim, August 14-20.

The first day's program will deal with the use of acoustical instruments in fishery research and be of interest primarily to researchers. On the second day, the use of acoustical instruments in fishing will be discussed.

Preparations are underway for a study conference on the "transport of fish from pier to consumer". The fair's planners hope to organize visits to foreign factory vessels and large trawlers, and study trips to the fishing grounds aboard one of the Marine Research Institute's research vessels.

NORTH SEA IS CLEANER

The North Sea off West Norway shows no signs of oil pollution and the volume of chlorinated aliphatic hydrocarbons is much less than in 1970, reports the Ocean Research Institute, Bergen, Norway.

A Norwegian-Swedish team has made a systematic collection of water samples in the area between Feie and Shetlands. It also has collected fish, which will be measured for hydrocarbons, DDT, lead, and other heavy metals.

The researchers believe that the improvement is due partly to the halt in 1971 of the dumping of industrial chemical waste.

CANADA

CANADA CURTAILS ATLANTIC SALMON FISHING

On April 24, Canada's Minister of Fisheries, Jack Davis, announced in the House of Commons a partial ban on commercial fishing for Atlantic salmon. It is expected to last at least 6 years and to close most of Canada's Atlantic salmon fishing grounds.

The action was brought on by excessive high-seas fishing by foreign countries, heavy fishing by Canadian commercial fishermen, and pollution in some main salmon rivers. The closure will affect commercial fisheries in several producing rivers in the Maritime Provinces and Port Aux Basques in Newfoundland. It will not apply to salmon returning to streams in Newfoundland, Labrador, or Nova Scotia. Davis reported a serious decline in salmon returning to the St. John, Miramachi, and Restigouche rivers.

The Plan

The cost of the program for the current fiscal year was estimated at $2 million. The ban will affect over 900 commercial fishermen. The plan anticipates buying out the commercial salmon fishermen--vessels, gear, and all. The move, reportedly, is designed to encourage Denmark to take similar action. Davis said the Danes have agreed with the U.S. to stop salmon fishing by 1975, but he contended that this will be too late to save the species.

Denmark & Norway

External Affairs Minister Mitchell Sharp said Canada had made vigorous representations to Denmark about its high-seas salmon catches. Canada was not satisfied with the Danish response and "wants exclusive rights to harvest salmon from our streams."

In a similar action, Norway has announced its intention to urge a total ban on salmon fishing outside national fishery limits. This hinges on other members of ICNAF and NEAFC engaged in the fishery undertaking the same obligation, with stricter catch limitations in any phase-out period. (U.S. Embassy, Ottawa, April 24.)

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CANADA'S ATLANTIC PROVINCES MADE RECORD EARNINGS IN 1971

In 1971, landings of Canada's Atlantic Coast provinces totaled 2.2 billion pounds, slightly below 1970 landings. They were worth C$128.9 million, surpassing the record set in 1970.

Groundfish, lobster, herring, and scallops were 95% of landings and 85% of value.

During 1965-70, landings of groundfish (mainly cod, flounders, ocean perch, and haddock) fluctuated between 1.10 and 1.24 billion pounds; in 1971, they totaled 1.13 billion pounds. Their value has been increasing steadily in recent years and reached nearly C$60 million, 11% above 1970's record.

Catch Composition Changes

Groundfish landings have changed in recent years. Cod were 10% less than in 1970. Still, they accounted for 39% of groundfish landings, compared to 52% in 1965. In 1971, the haddock catch increased but was still substantially below level of earlier years. In recent years, ocean perch and flounder have accounted for a larger share of the total groundfish landings. In 1971, ocean perch were 22% (12% in 1965), flounder 25% (18% in 1965). However, 1971 flounder landings declined 6% from 1970 record of 299 million pounds.

Herring Fishery Expands

The herring fishery has expanded appreciably since 1965. From 405 million pounds in 1965, landings increased to 1.16 billion pounds in 1968. They have declined annually since then: in 1969, by 7% and, in 1970, by 2%. In 1971, herring catches declined again, by about 12%. They were 41% of all fishery landings but only 10% of total value.

Lobster landings, which have been ranging between 35 and 40 million pounds, rose only slightly in 1971. Their increased value reflected higher market prices.

The low abundance of sea scallops on traditional fishing grounds has contributed to

CANADA (Contd.):

decreased catches in recent years. Landings decreased 14% in 1971, but prices reached records. The Atlantic salmon catch of 4 million pounds was about 1 million pounds less than in 1970. ('Canadian Fishermen' and 'Canadian Fisheries Statistics').

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NEWFOUNDLAND LANDINGS FELL 13% IN 1971 BUT VALUE ROSE

In 1971, landings in Newfoundland declined 13% from 1970, but their value to fishermen set a record. The catch totaled 388,600 metric tons worth US$35.3 million. Of the total catch, groundfish registered 242,200 tons, down 13% from 1970. Cod declined 10% from 127,700 tons in 1970. Flounder slipped 13%, ocean perch 37%, and Greenland turbot 4%. Herring landings also fell: 134,500 tons, compared to 159,100 in 1970.

The salmon catch decreased almost 16% to 1,500 tons. Salmon anglers landed 12% fewer fish. In 1970 and 1971, there was full-scale tagging of smolt and adult salmon in Labrador. This project is part of an international study to determine the origins of salmon stocks exploited in Greenland area.

Mollusks & Crustaceans

Landings of mollusks and crustaceans totaled 5,800 tons, compared to 2,700 tons in 1970. The lobster catch declined 6% to 1,400 tons. Scallop landings dropped to nearly three-quarters of 1970 catch; however, new stocks have been located in many areas. Encouraging results were reported for experimental scallop farming introduced in 1971. After 3 seasons of virtual failure, squid are showing signs of reappearing; landings totaled 1,800 tons in 1971, compared to 80 tons in 1970.

Bait Subsidized

The Newfoundland Bait Service provided 4 million pounds of bait at subsidized prices to inshore fishermen in 1971. Some problems were encountered in catching enough herring for bait as a result of accelerated demands for food processing. However, there were enough capelin for bait purposes. Squid have been extremely scarce recently, but fishermen have found mackerel an acceptable bait substitute. Good signs of mackerel in Newfoundland waters were noted; limited landings were used by food processors and for bait.

The Fishing Vessel Assistance Program approved applications to construct 83 vessels 45 to 50 feet. Approximate construction costs amounted to $3,265,000. (Canadian Department of the Environment Fisheries Service.)

LATIN AMERICA

MEXICO'S FISH INDUSTRY GAINED 7% IN 1971

In 1971, Mexico's fish industry produced 273,154 metric tons of all species, a gain of 7.3% over 1970, according to preliminary figures of the Secretary of Industry and Commerce.

Among edible species, sardines gained the most: 37.6%; anchovies and turtles showed the biggest declines: 42.2 and 44.8%. Production of shrimp, the biggest money crop, fell 3.1%. Fish meal continued upward, although more slowly than in 1970; it increased 10.8% to 21,509 tons. However, production is still far below Mexico's requirements.

Shrimp Exports Rose

Despite slightly lower shrimp production, Mexico's exports of shrimp increased 6.2% to 30,582 tons, and 9.7% in value to US$69.3 million. Although most shrimp exports went to the U.S., the traditional principal market, exports to Japan increased 91% over 1970, totaling 1,999.3 tons. This trend is expected to continue in 1972. As a result of record shrimp prices in the U.S. and Japan, shrimp exports for the first time ranked third in total exports, although well behind tomatoes and sugar.

NORWAY'S LOFOTEN FISHERIES ARE THE BEST SINCE 1951

The Lofoten cod fisheries in North Norway, which ended April 26, were the best since 1951, reports the Royal Ministry of Foreign Affairs. Six thousand men landed 97,000 tons of cod, 17,500 tons more than in 1971. The 1951 catch was 115,000 tons, but the number of fishermen was 20,000--more than 3 times this year's.

Average earnings of fishermen in the Lofoten fisheries this year are estimated at almost 50,000 kroner (£3,000, $7,000).

About 58,000 tons of the catch have been salted, about 17,000 tons dried, and the remainder filleted for freezing or sold fresh.

FISHERMEN DOWN 40%

In 10 years, the number of fishermen in Norway fell 40%--from 61,000 in 1960 to 35,000 in 1970--according to census returns of the Central Statistical Office, Oslo. Johan Toft, chairman of the Fishermen's Federation, attributes the reduction to rationalization: "Crews have been reduced, but the catch per man has increased and is bigger today than ever before."

FROZEN FISH EXPORTS RISE 41% IN VALUE

The frozen-fish marketing organization Frionor, Oslo, reports that exports in first-quarter 1972 were up 22% in volume and 41% in value over the 1971 period. Shipments totaled 17,000 tons worth more than 100 million kroner (£6 million, $14 million).

NORWEGIAN FISH-OIL PRODUCTION ROSE 3% IN 1971

In 1971, Norwegian fish-oil production was 194,400 metric tons, an increase of 3% from 1970. Year-end supplies were 150,000 metric tons larger than at year-end 1970. Increased production is expected during 1972. The main fish used for fish oil and meal in 1971 was capelin, caught primarily off the north Norway coast.

Little Whale Oil

In 1971, whale-oil production totaled only 194 metric tons. In earlier years, it had been the main source for the oil industry. Two land stations won approval to operate in 1971, but only one considered it profitable enough to do so. In first-quarter 1972, the Norwegians have not sought Antarctic whales. One result is the shortage of raw material for the refining and hardening industry. The U.S. has been a main foreign supplier of oil for this industry; it has supplied nearly half the oil imports. ('Foreign Agricultural Service', U.S. Dept. of Agric., April 12.)

'GIVE A MAN A FISH HOOK. . .'

The fish-hook manufacturer O. Mustad & Son A/S, Oslo, reputedly the world's largest, has sent 300,000 fish hooks to the Red Cross in Bangladesh. The gift followed a letter home from the owner's daughter, Anne Mustad, a physiochemist working with a Norwegian medical team in Bangladesh. Her letter quoted the Bangladesh adage: "Give a man a fish and he has food for a day. Give him a fish hook and he has food for life."

ICELAND IS ADDING 27 STERN TRAWLERS

Iceland has authorized 27 stern trawlers 400 to 1,000 gross registered tons, reported 'Fishing News' of London on March 17. An agreement was being negotiated with Japanese shipyards to build 10 stern trawlers averaging about 500 GRT each. Four vessels have been ordered from Spain (one has been completed). Norway is building 10 vessels of about 500 tons each; two are being built in Poland. Iceland's shipyard will construct one 500-ton vessel.

Fleet Modernization

The fleet-modernization program, with deliveries slated for 1972-73, is the first recruitment to the trawler fleet since 1960. Total investment will be US$30 million, supported by loans from the Fisheries Fund that

ICELAND (Contd.):

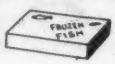
may cover two-thirds of cost of vessels built abroad. In 1970, the trawler fleet caught 16% of the production of groundfish species and, in 1971, 23%.

If Iceland succeeds in extending her fishing limits to 50 miles, as proposed, it could create a vast protected area for the incoming fleet of stern trawlers.

Iceland's 1971 Frozen-Fish Production

In 1971, Iceland produced 93,000 metric tons of frozen fishery products. Cod fillets and blocks were 35,000 tons of total, down 4,000 tons from 1970. About 47% was fillets and 53% blocks. Haddock fillets totaled 6,220 tons (up 22% from 1970) and blocks 348 tons. Saith (coalfish) totaled 13,745 tons, the bulk fillets for the Soviet and Czechoslovak market; there also was an increase in blocks for the U.S. Shrimp and Norway lobster production rose 14% to 1,504 tons, while scallops increased 58% to 380 tons.

The U.S. was Iceland's leading export market for frozen fillets and blocks with 53,230 tons; the Soviet Union was second with 12,383 tons. ('Aegir', March 1972.)



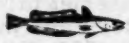
MARINE FISH FARMING PROGRESSES IN UNITED KINGDOM

Experiments are underway in the United Kindgom (UK) to develop a profitable marine fish-farming industry. They have concentrated on the marine flatfish--plaice, Dover sole and, more recently, turbot and lemon sole.

Results have shown that these species can be spawned under artificial conditions. Large numbers of plaice and Dover sole have been hatched, reared, and marketed. Each species is assessed by these criteria: high market price, fast gain in weight, and ease of breeding and rearing of young in captivity.

High Priced Are Profitable

In terms of profitability, those species found to give economic returns are the high-priced ones: turbot, Dover sole, hake, and halibut; those most unlikely to give economic returns are red sea bream and plaice. ('Marine Fish Farming', Suffolk and Lowestoft Laboratories, UK.)



SCOTTISH SHRIMP AND SHELLFISH BOOM

There has been a marked increase in Scottish shellfish landings in the past 20 years. Shellfish landings reached 22,220 metric tons in 1971, and value US$10.9 million.

The growing popularity of Norway lobster (or prawn) spurred growth of landings form 152 metric tons in 1950 to 1,981 metric tons in 1960 and 8,178 tons in 1970. The value of this catch in 1970 was nearly US$4.5 million. Scallop fisheries began in the 1960s and, by 1970, totaled 8,788 tons worth US$2.1 million. Recently, the pink shrimp (Pandalus sp.) became a target. Three species are found around the Scottish coast.

Rich Fladen Grounds

The prolific Fladen grounds near Scotland, long fished by Scandinavian shrimp vessels, are providing an increasing catch for Scottish vessels. The latter's early efforts failed because a market did not exist in Britain. The growing demand in Britain for pink shrimp has led to an import trade worth US$12.4 million a year. This market has stimulated Scottish fishermen. Both pink and brown shrimp are available close to shore. Expansion of this fishery is expected. Peeling machines have been installed to handle the growing catch.

Norway Lobster

Norway lobster now is caught only during short periods at dawn and dusk in shallow waters. Investigation is underway to learn whether electrified trawl will extend fishing results. Tests in natural habitat have shown positive results in making a significant percentage of these lobsters leave their burrows. Eventually, the electrified trawl likely will become a practical commercial proposition to stimulate production of Norway lobster and shrimp. ('Scottish Fisheries Bulletin')

VALUE OF IRISH CATCH + EXPORTS UP IN 1971

In 1971, Ireland's catch, excluding salmon, was worth a record Ł4.2 million, 7% above 1970, according to the Department of Agriculture and Fisheries. This was reported in 'The Irish Skipper', May 1972. The industry contributes about Ł10 million to the national economy. It "reflects the substantial increase from added value to landings in the processing, distribution and export sectors."

The value of fish and fishery products increased 22% to Ł5.6 million. Herring and shellfish were mainly responsible: their values rose Ł500,000 and over Ł250,000.

The whitefish catch increased from 302,000 hundredweight (cwt.) to 406,000 cwts. Value went up 11%--from Ł1.4 m to Ł1.6 m. Landings of cod and haddock were responsible for the improved results. Catches of pollock, megrims, and dabs dropped slightly.

Shellfish Up 18%

In 1971, shellfish values rose 18%, from Ł1,102,000 to Ł1,302,000. The increase was brought about by a striking increase in some catches (1970 figures in parentheses):

crawfish	179,000 fish	(155,000)
crabs	1,847,000	(1,265,000)
escallops	2,281,000	(323,000)
oysters	2,940,000	(1,619,000)

Mussel production went up nearly 50% in 1971: from 66,000 cwts. to 93,000.

Herring Returns

The 1971 statistics do not cover the 1971/72 winter herring season. Good returns were reported despite the season's late start. In a few weeks, the fleet landed 27,000 tons worth Ł1,119,000.

These landings put Ireland ahead of Belgium and Holland and closing quickly on France and Germany.

During the winter herring season, Killybegs alone exported salted and spiced herring worth Ł150,000 to Scandinavia, including Norway.

France has imported salted herring and frozen herring fillets worth Ł112,000; Belgium and Germany mainly frozen fillets valued at Ł180,000.

Britain and Holland bought more than Ł250,000 worth of herring.

FRANCE ORDERS 13 STERN TRAWLERS FROM POLAND

Poland's Gdynia shipyards will deliver 13 vessels to France by 1973. Known as the B423, they are medium-range, highly efficient, stern trawlers, 178 ft. long and average 320 tons (dwt).

The vessels are designed for demersal and pelagic fishing in the North Atlantic and North Sea. The 'Otter Bank' and the 'Cap-Sainte-Marie', first of the new class to be completed, are in operation. From 1960 to 1970, Poland delivered 27 trawlers to France.

CONSTRUCTS 4 DISTANT-WATER TUNA SEINERS

Under the French Sixth Fisheries Plan, 4 distant-water tuna purse seiner-freezers are to be built by 1975. Two were launched in Dec. 1971. One, the 'Morgat', is 189 ft.; the other, the Sapnish-built 'Guipuzkoa', 248 ft. The French say this is Europe's largest tuna freezer.

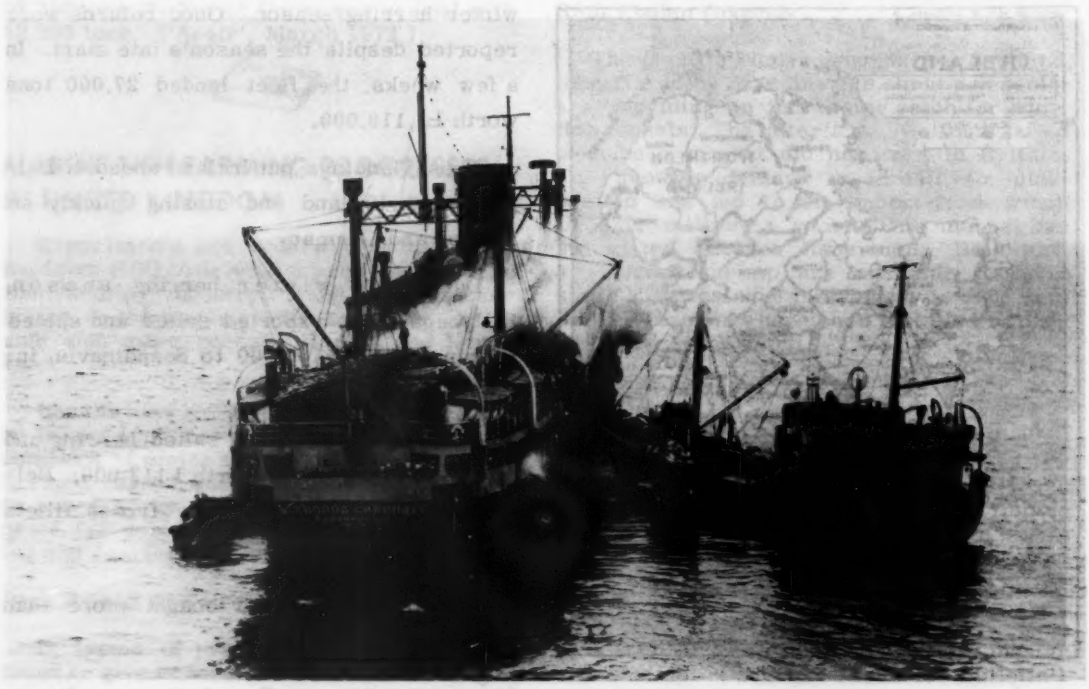
French shipyards will build the remaining two tuna vessels.

These 4 new vessels will increase the freezer fleet to 28 tuna vessels, all constructed recently. Total production capability will be 50,000 tons/year. In addition, reconverted seiners will add another 10,000 tons.

BELGIUM'S 1971 CATCH ROSE, PRICES FELL

Belgium's catch rose about 7% in 1971, but average market prices fell. The catch increase was attributable mainly to the cod catch, which was 84% above 1970. Catches of almost all other species showed declines for 1971.

Belgian fishermen operate in the southern part of the North Sea, the Irish Sea, and Icelandic waters. ('France Peche,' Mar. 1972.)



Soviet factory ship 'Vsevolod' in Bering Sea.

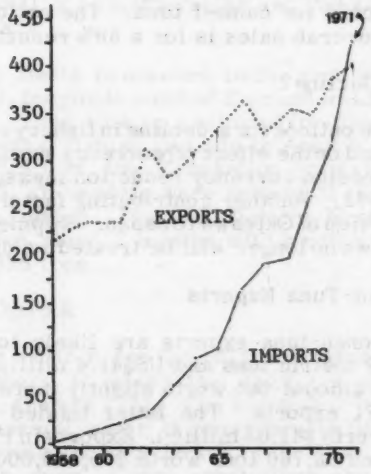
JAPAN BECOMES MAJOR IMPORTER OF FISHERY PRODUCTS

In 1971, Japan became a major importer of fishery products. Thus ended a long tradition as one of the world's principal suppliers.

In 1971, the value of Japanese fishery imports reached US$426 million. For the first time, this exceeded exports of fishery products, which were valued at $406 million.

YEAR	EXPORTS	IMPORTS
1971	406	426
1970	391	318
1969	347	261
1968	351	200
1967	326	192
1966	362	168
1965	331	104
1964	311	90
1963	283	59
1962	313	30
1961	229	23
1960	234	15
1959	233	8
1958	221	3

Shrimp, octopus, squid, and skipjack tuna were nearly 78% of the total value of imports. At the same time exports of tuna declined, due to mercury and canned-tuna decomposition problems, from $40 million to $13 million. Swordfish exports fell to nearly zero. ('Suisan Keizai', Apr. 10.)



Value of marine imports and exports, 1958-1971 (in US$1 million).

* * *

PLANS GIANT FISH FARM

Japan's largest fish farm is planned for the waters off Kushimoto, Wakayama Prefecture. It is expected to be partly operational in 1974, but it will not be completed until 1976. Cost is estimated at US$7 million.

The farm will enclose 114 hectares (1,140,000 square-meters) of water, surrounded by concrete breakwaters in the sea. About $7.3 million worth of lobster, yellowtail, and sea bream is expected to be harvested annually.

The fish farm is one of 15 planned under the Japan Fishery Agency modernization program that began in 1970. ('Japan Times', Apr. 21.)

* * *

VESSEL EXPORTS INCREASE

Japanese exports of fishing vessels have increased from about 100 a year up to 1966, to 166 in 1967, 145 in 1968, 152 in 1969, 139 in 1970, and 301 in 1971. One explanation for the sharp increase in 1971 was that fishermen rushed to replace their vessels with new ones because exports of used vessels were slated to be prohibited at the beginning of fiscal year 1972 (April 1, 1972).

* * *

JAPAN

DECLINE IN 1972 FISHERY EXPORTS PREDICTED

A report on fishery exports in fiscal years (FY) 1970 and 1971 and FY 1972 outlook has been published by the Japanese Agriculture and Fishery Products Export Council. A fiscal year begins in April and ends in March the following year.

Projections for FY 1972 show a decline in value of exports from FY 1971 for most items. Fresh-and frozen-tuna exports are likely to approximate the 1971 figure. A 43% gain is projected for canned tuna. The outlook for canned-crab sales is for a 69% reduction.

Why Decline?

The outlook for a decline in fishery exports is based on the effect of currency revaluation and foreign currency reduction measures in FY 1972. Another contributing factor is the reversion of Okinawa to Japan. Shipments to Okinawa no longer will be treated as exports.

Frozen-Tuna Exports

Frozen-tuna exports are likely to reach 77,607 metric tons and US$41.4 million--the same amount but worth slightly more--than FY1971 exports. The latter totaled 77,607 tons worth $41.05 million. Exports in FY1970 reached 66,760 tons worth $35,068,000.

The outlook for frozen-tuna exports in FY 1972 is that albacore and skipjack shipment will increase; yellowfin exports will decline because mercury problem in Italy remains unsolved. ('Suisan Tsushin', May 30, 'Katsuo-Maguro Tsushin', June 1.)

* * *

FISHERY INFORMATION CENTER OPENS

An organization to provide fishery information to Japanese coastal and offshore fishermen has opened in Tokyo. It is named Fishery Information Service Center. Director is Ryuichi Kikuta, president, National Federation of Fishery Cooperatives (ZENGYOREN).

The center replaces the former fishery forecasting service, a government-subsidized program in existence from July 1965 until March 1972. The new center will be financed primarily by the users, but it also will receive government aid.

Its Services

Services to be provided include: 1) continuation of existing program of disseminating fish bulletins and long-term forecasts for 10 fish species--including albacore and skipjack tuna, anchovy, saury, salmon, and sardines--fished off Japan's Pacific coast; 2) expansion of present investigations by survey vessels; 3) transfer from government laboratories of the program of processing sea-surface temperature data transmitted by aircraft (activity to be partly subsidized by government); 4) collection and dissemination of information obtained from fishing vessels (government to subsidize 50% of this work); and 5) distribution of red-tide warnings to fish-culture operators in shallow waters and in bays.

By Radio & Facsimile

Information will be transmitted to the vessels by radio and facsimile. At present, only about 3,000 of the 8,000 vessels equipped with facsimile recorders are operating off Japan's Pacific coast. To improve fishing efficiency, facsimile is likely to become more important in the Japanese coastal and offshore fisheries. ('Suisan Keizai Shimbun', Apr. 27.)

* * *

NEW YORK OFFICE TO SERVICE TUNA LONGLINERS

NIKKATSUREN will open an office in New York on July 1 to provide better refueling and other other services to its member vessels fishing off the U.S. East Coast. NIKKATSUREN is the Federation of Japan Tuna Fisheries Cooperative Associations.

The need to refuel at foreign ports is increasing for Japanese tuna longliners because their hook rate is declining and trips must be extended.

NIKKATSUREN also will open an office in Panama. It already has agents in South Africa, Australia, New Zealand, and other places ('Suisan Keizai Shimbun', May 25.)

* * *

JAPAN (Contd.):

SITUATION EASES ON CANNED-TUNA EXPORTS TO U.S.

On Feb. 24, 1972, the Tokyo Canned Tuna Sales Co. resumed sales of canned-tuna-in-brine for export to the U.S. Sales had been suspended because of decomposition problem. Since Feb. 24, 700,000 cases (600,000 cases of canned white-meat tuna and 100,000 cases of canned light-meat tuna) have been sold to trading firms; some early shipments were arriving in U.S. ports in late April. U.S. customs clearance is proceeding smoothly. There were no rejections at major ports of entry, notably New York, where much is received. Easing of the situation is attributed to voluntary inspection and self-certification by Japanese tuna packers. ('Suisan Tsushin', Apr. 26.)

* * *

CANNED TANNER CRAB PRICES ARE LIKELY TO INCREASE

The 1972 Japanese quota for tanner crab off East Sakhalin is 13 million crabs, same as for 1971. The production of canned product from that catch is expected to be around 135,000 cases (70,000 cases for home and 65,000 cases for export). The 1972 sales prices for canned tanner crab, domestic market and foreign, are likely to increase over 10% above 1971 levels. This outlook is based on the rapidly rising domestic demand: possibly 120,000-130,000 cases will be sold because of the sharply reduced supply of canned king crab that will be available this year. Practically all Bristol Bay king crab are being frozen, so the 105,000 cases to be packed from the West Kamchatka catch will be all the canned king crab available this year.

Prices to Rise

Japanese export-price quotations for canned tanner crab can be expected to increase to $33-35 a case from the $30 quoted in late 1971. (In 1971, export prices rose from $25.50 to $27 and, finally, to $30 in November.) However, such high prices likely will limit sales to certain established brands, such as "Geisha" label. U.S. will be the only large market. As for canned king crab, if they are exported in 1972, prices would have to be substantially increased above the 1971 quotation of $60 a case. ('Suisan Tsushin', May 11.)

* * *

SALMON MOTHERSHIP FLEETS DEPART FOR NORTH PACIFIC OCEAN

On May 17, 10 Japanese salmon mothership departed Hakodate, Hokkaido, for the North Pacific Ocean. The 332 catcher vessels assigned to the motherships left May 15. The 1972 fleet was reduced 10% (or by one mothership and 37 catcher vessels) from the 1971 total of 11 motherships and 369 catcher vessels.

The fleets proceeded to the area west of 168° E. longitude south of Komandorskiye Islands. They took up positions for fishing in the central fishing grounds in Area A (north of 45° N.) of the Convention waters. By May 22, all vessels were scheduled to commence fishing. They will fish the North Pacific for about 3 months with a catch target of 35,326 tons.

1972 Outlook

The outlook for the 1972 high-seas salmon fishery is about the same, or slightly better, than in 1971. The somewhat-higher-than-normal water temperature is likely to accelerate the northward migration of the salmon runs. Catch predictions are for a medium catch of red salmon, good landings of pinks for a lean season, better-than-average run of chums, and a substantial increase in catch of silvers if the vessels delay their departure from the fishing grounds. ('Suisan Tsushin', May 18.)

* * *

WHALING FLEETS DEPART FOR NORTH PACIFIC OCEAN

In mid-May, 3 Japanese whale factoryship fleets departed for the North Pacific whaling operations. The quota for the 21st (1972) North Pacific whaling season has been reduced 20% to 554 blue whale units (BWUs). Each fleet has a Soviet observer aboard.

日本

SOUTH PACIFIC

AUSTRALIAN FISHERIES SET VALUE RECORD IN 1970-71

The value of Australia's fishery production for 1970-71 exceeded US$112 million, 27.5% higher than 1969-70 period. This increase is attributed primarily to the rise in production and value of crustaceans. The value of lobster catch alone rose over 43% to a record US$45.1 million; this reflected high prices paid for Australian rock-lobster tails in the U.S.

Rock-lobster production rose more than 13% between 1970 and 1971; it reached 28.5 million pounds in 1971. In the main lobster-producing area, Western Australia, the catch rose to 17.8 million pounds worth a record US$28.8 million.

In 1971, prawn production showed spectacular increases in value (32%) and quantity (43%). In quantity, prawns are now Australia's most important single fishery item.

Mollusks Increased

Production of mollusks increased in quantity and value. Oyster production rose 5% to 21.7 million pounds, its value almost 11% to US$8.6 million. The downward production trend of scallops and abalone of the last two years was reversed in 1970-71. Scallop production rose 47% in quantity and 88% in value to almost 18 million pounds worth US$2.6 million. Abalone production rose 31% in quantity and 81% in value to 17.6 million pounds worth US$5.9 million.

Prices for Australia's wetfish catch also increased despite a catch decline of almost 7% to 113.6 million pounds--due mainly to lower shark, snook, and Australian salmon catches. However, total earnings for 1970-71 decreased only marginally to US$24.5 million.

Western Australia No. 1

Western Australia continued as leading fishery State. Its production in 1970-71 was valued at US$35.8 million, compared with US$16.1 million in 1969-70. New South Wales was second: its production value increased from US$21.6 million in 1969-70 to US$24.5 million in 1970-71. Queensland's production value increased sharply from US$10.1 million in 1969-70 to 15.5 million in 1970-71. The increase was attributed mainly to the large jump in Queensland's prawn production. South Australia, Victoria, Tasmania, and Northern Territory also registered increases in catch value in 1970-71.

Early-1972 Situation

In early 1972, the 1971-72 fishery season showed fairly good rock-lobster catches. The price paid to lobster fishermen was about US$1.95 per lb. Catches in Tasmania and Victoria were generally encouraging, while in South Australia the fishing season was poor. South Australia's fishermen have been hampered by poor weather and late running lobsters, but market prices, nevertheless, have remained favorable.

N. Australia Shrimp Leader

Northern Australia is now the top shrimp-producing area. The fishery includes waters north of 20th parallel off Queensland, north of Bowen, in Gulf of Carpentaria, off Northern Territory, and in the Arafura Sea. It started on major scale in 1968 with a catch of about 5 million pounds, more than double 1969 catch, and climbed to 15 million pounds in 1970. In 1971, a catch of 23 million pounds was anticipated. In 1971, 230 boats were fishing shrimp.

The area's potential is good. About half the shrimp were landed at Darwin. The fishery is still developing, so it is likely to maintain present growth rate.

About 86% of catch was banana prawn, (Penaeus merguiensis), 9% tiger prawn (Penaeus esculentus).

Gulf of Carpentaria

The Gulf of Carpenteria catch of over 12 million pounds set a record. The lowest price paid was 30 cents (Australia) per pound, rising to 50 cents; it was worth over A$5 million to fishermen. (A$1 equals US$1.12.) Other northern fisheries also were expected to set new records. Shrimp also are found off south, east, and west coasts.

OYSTER DREDGING: NEW ZEALAND'S UNIQUE INDUSTRY

The New Zealand dredge oyster industry is unique: it is the world's only remaining natural fishery for "flat" oysters, which are cropped without any attempt at cultivation. So states the country's Information Service. Elsewhere, fishing has been controlled, and similar resources of naturally occurring stocks have ceased to be commercially exploited.

The industry is one of New Zealand's oldest. Small quantities from Stewart Island were being marketed back in 1830. The industry was centered there. But, as stocks around the island became exhausted, the oyster boats explored out to Foveaux Strait, Centre Island, and Ruapuke Island up to 1880. Early this century, the industry was transferred to Bluff.

Oyster Grounds

Oysters occur over 300 square nautical miles in Foveaux Strait. The commercially fishable grounds cover about 120 square miles, mainly along the Strait's central regions, in 9 to 21 fathoms.

There has been concern for the oyster stocks and the possibility of exhausting them through overfishing. The fishery now is self-guarded by regulations varying according to circumstances. Among conservation measures are the quota, closed season, and number of boats permitted to dredge.

The Quota

Fixing a maximum amount of oysters that may be taken commercially during the season ensures that an adequate stock remains to maintain the fishery.

The quota was introduced in 1963 at 170,000 sacks. It has been reduced in recent years to reflect declining numbers of oysters. Now it is 110,000 sacks to be taken by the 23 oyster boats at Bluff. Although much smaller than total annual catches from 1966 to 1968, it is still higher than the average annual catch for the past 25 years.

The Marine Department has been interested actively in conservation measures that may assist regeneration of the natural stock. These include farming and the return of shell to the oyster grounds.

Fig. 1 - In Foveaux Strait oyster beds, there are 600 million oysters that may be taken for eating. About one-sixth will reach market. During the coming season, from March 1 to about end of August, 23 oyster boats, some seen here, will take 110,000 sacks.

Fig. 2 - Dredge nets are used on New Zealand oyster boats that fish out of Bluff harbor into Foveaux Strait. Here a net is being swung inboard, and the catch tipped onto a cultching bench for sorting. (Cultching is separating the shells of takable size, believed to contain oysters, from material dredged from bottom.)

The New Zealand Marine Department advocates return of opened shell to the sea. From 1970 trials, when 1,000 sacks of shell were returned to an area of Foveaux Strait, the results of regeneration have been encouraging.

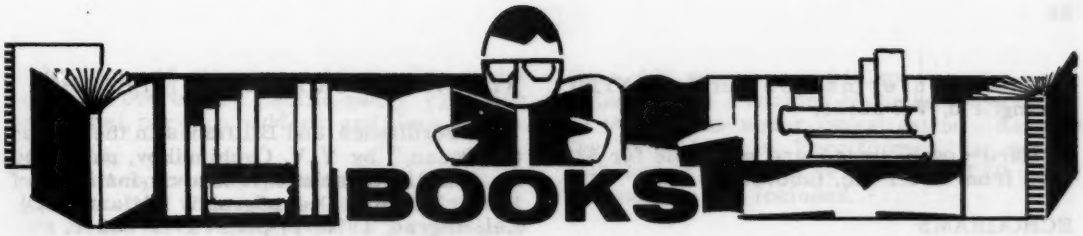
Returning Open Shell to Sea

The return of opened oyster shell to the sea has been advocated for two reasons. Oyster larvae usually settle on living or newly dead oysters. When beds are thinned by dredging, the material on which "spat" settle is removed, and so the number of oysters settling successfully is reduced. Adhering to the shells of the larger oysters are small oysters called "wing." Wings are still alive when the shells are opened. If they were returned to the sea in reasonable time, they would have a good chance of surviving and growing.

In 1970, 1,000 sacks of shell were returned to part of Foveaux Strait as a trial. The sacks were put down in a small area not dredged by boats. Then, it was roped off and samples taken every two months. Results have been encouraging. There was a high survival and good growth of wing oysters and a reasonable spat fall on the shell in the summer.

Foveaux Strait's Beds

There are 600 million oysters in the Foveaux Strait oyster beds that may be taken for eating. Only about one-sixth will reach the market. Conditions are reviewed months before the season starts (March 1 to about end of August). Management decisions, backed by scientific evidence, ensure that oysters are reasonably available to the public, profitable to fishermen, and protect a unique New Zealand industry.



TRANSLATIONS OF FISHERY BOOKS

The National Marine Fisheries Service (NMFS), under Public Law 480 Translation Program, contracts for the translation of books on fishery subjects. Supervising the operation is Milton Rose, Head, Translation Unit, International Activities Staff.

The following three Soviet monographs were translated recently in Israel. Paperbacks are $3.00 each--from National Technical Information Service (NTIS), Springfield, Va. 22151. When ordering, include the number following the number of pages in the translation: for example, TT 71-50066 after 207 pp. in item below.

MARINE NEUSTONOLOGY

"Marine Neustronology," by Yu. P. Zaitsev, "Naukova Dumka" Publishers, Kiev, 1970, 207 pp., TT 71 50066.

Neustonology deals with the minute organisms that float in surface film of water. This is the first monograph published on the biology of the sea surface. It describes methods of analyzing the structure, composition, density, ecology, dynamics, and distribution of the neuston. It discusses the neuston's important role in the reproduction of marine organisms and the cycle of substances in nature. The book evaluates the significance of neustonology in measuring the utilization, regeneration, and protection of the world's marine resources.

Hard-cover copies are sold for $16 each by Keter Inc., 104 East 40th St., New York, N.Y. 10016.

NEW FISHERY PRODUCTS

"Products from New Ocean Fish," by A. S. Lazunova and S. A. Lukoshkin, "Pishchevaia Promyshlennost'" Publishers, Moscow, 1969, 21 pp., TT 71-50031. It describes marine fish species that are new to the Soviet fishing and fish-processing industries. It discusses the possibilities of increasing the variety of manufactured fishery products. Methods for working out cost estimates, and wholesale and retail prices for new products are included.

TRAWLING N. ATLANTIC SLOPE

"Trawling Resources on the North Atlantic Continental Slope," by L. N. Pechenik and F. M. Troianovskii, "Murmanskoe Knizhnoe" Publishers, Murmansk, 1970, 66 pp., TT 71-50065.

Describes the results of exploratory fishing along the North Atlantic continental slope, 1963-1968, by vessels of the Soviet Northern Fishing Reconnaissance Fleet. During 34 cruises, more than 3,500 deepwater trawls were made. From the accumulations of fish discovered in these regions, the fleet caught about 200,000 metric tons, even though a limited number of vessels fished sporadically. Also, the booklet describes the main features of trawling at great depths. This is based on the experience of the skippers of search and fishing vessels--"pioneers of deepwater trawling."

GENETICS

"Genetics, Selection, and Hybridization of Fish," edited by B. I. Cherfas, published in 1969 under auspices of Ichthyological Commission, USSR Academy of Sciences. Contains 28 papers delivered at First All-Union Conference on Genetics, Selection, and Hybridization of Fish, Leningrad, March 1967. Covers these topics on freshwater fishes: genetics and karyotype of carp and other commercial species; theoretical and practical aspects in selection and breeding of carp, trout, and other pond fishes; biochemical and hereditary polymorphism in various species; and hybridization and heterosis of fish. The 269-pp. book is sold in paperback as TT 71-50112 for $3.00 each by National

Technical Information Service (NTIS), Springfield, Va. 22151.

Hard-cover copies are available for $21 each from Keter Inc. (above).

ECHOGRAMS

"Interpretation of Echograms of Hydroacoustic Fish-Finding Instruments," by K. I. Yudanov, "Pishchevaia Promyshlennost'" Publishers, Moscow, 1967, 101 pp. TT 71-50032.

It is a systematic survey of the principles of reading and interpreting echograms of hydroacoustic fish-finding instruments. It investigates technical and biological principles affecting the character of echograms. It describes types of distortion in recordings of fish concentrations and the masking of indicators of demersal fish. The author analyzes the possibilities of determining the species and quantities of fish recorded in the echograms of hydroacoustic instruments.

Paperbacks $3.00 each NTIS. Hard-cover copies $10 from Keter Inc.

FISH BEHAVIOR & FISHING TECHNIQUES

"Fish Behavior and Fishing Techniques," edited by A. P. Alekseev, published by Polar Research Institute of Marine Fisheries and Oceanography (PINRO), Murmansk, 1968, 193 pp., TT 71-50010.

Contains 28 papers presented at the All-Union Conference on Fish Behavior and Fishing Techniques, Murmansk, Feb. 27-March 1, 1968. Some subjects covered are trends and results of Soviet research; means to achieve productive fisheries; underwater research techniques; behavior in electric fields; use of communication and orientation signals of fish; light fishing for saury and squid; optomotor reaction and fishing; behavior in trawl's zone of action; underwater illumination; behavior in a zone affected by a curtain of air bubbles; daily rhythm in trawl catches; diurnal vertical migration; importance of fish's sense of smell; swimming speeds of fish.

Paperbacks $3 each from NTIS. Hard-cover copies $14 each from Keter Inc.

ATLANTIC SWORDFISHES & BILLFISHES

"Swordfishes and Billfishes in the Atlantic Ocean," by V. V. Ovchinnikov, published by Atlantic Scientific Research Institute of Fisheries and Oceanography (AtlantNIRO), Kaliningrad, 1970, 77 pp., TT 71-50011.

This studies biology and behavior of swordfishes, sailfishes, marlins, and spearfishes--all belonging to superfamily Xiphioidae. It stresses ecology and functional morphology of swordfishes and sailfishes.

OCEAN'S LIVING RESOURCES

"The Living Resources of the World Ocean," by Prof. P. A. Moiseev, Assistant Director, All-Union Research Institute of Marine Fisheries and Oceanography (VNIRO), published by "Pishchevaia Promyshlennost'," Moscow, 1969.

Moiseev attempts to solve two chief modern problems: the productivity of the world ocean at various trophic levels, and the evaluation of potential fish productivity. He studies the world ocean on the basis of biological data and on the physicochemical properties of the ocean as producer of living resources. He bases his evaluation on analysis of the varied and complex interrelationships of the marine ecosystems. He singles out the most important factors determining the volume and composition of fishery products. These include fishes, large invertebrates, and aquatic mammals. Moiseev discusses volume of commercial productivity of the world ocean and the prospects of fishery developments. He expresses his opinion of previous evaluations.

The 334-page book, paperback, costs $6 from NTIS, Springfield, Va. 22151, as TT 71-50026. Hard-cover copies are $26 each from Keter Inc.

COMMERCIAL FISH CONCENTRATIONS

"Biological and Oceanographic Conditions for the Formation of Commercial Concentrations of Fish," edited by P. A. Moiseev, published in "Proceedings of the All-Union Research Institute of Marine Fisheries and Oceanography (VNIRO)," Vol. 60, Moscow, 1966.

It contains 25 papers by Soviet scientists on conditions for formation of concentrations,

behavior, and structure of fish. The major species covered are Pacific saury, cod, jack mackerel, herring, haddock, and black halibut.

Other topics are: peculiarities in biological system of Polar Basin and Soviet Northern Seas; force and speeds of migration of fish, dolphins, and whales; hydrochemical, hydrometerological, and hydrobiological characteristics of formation of primary production in marine waters; principles of classification of shelf zone; and underwater observations of the Bering Sea.

The book, TT 67-59063, costs $3, from NTIS.

THE PERCOIDEI

"Fishes of the Sea of Japan and Adjacent Areas of the Sea of Okhotsk and the Yellow Sea," Part 3, Telcostomi, XXIX, Perciformes, by G.U. Lindberg and Z. V. Krasyukova, published by Soviet Academy of Sciences in 1969.

The book covers the Percoidei, the most extensive suborder in the order of Perciformes. It includes 13 superfamilies; 10 of these are known from the Sea of Japan and adjacent waters. The book includes 55 families, 137 genera, and 248 species that comprise almost a quarter of the known species in the oceans under investigation. Keys to the suborders of Perciformes, to superfamilies of suborder Percoidei, and 10 of the 13 families are included.

The 498-page book, paperback, TT-31-50045, is $6 from NTIS. Hard-cover copies are $32 each from Keter Inc.

CRAYFISH

"Manual for Crayfish Catchers," by Jerzy Paladino, published in Warsaw in 1966, translated in Poland.

The book tells you how to distinguish between species of crayfish, their biology, including external appearance, internal anatomy, sexual organs and reproduction, development, habitats, distinction between males and females, and mode of life.

Also discussed are types of crayfish-catching gear, baits, packaging methods, and the legal and financial statutes and regulations covering crayfish in Poland.

The book, 67 pages, TT 70-55115, costs $3, from NTIS.

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BACK COVER: A sea of shells at Puerto Montt, southern Chile.

(FAO/S. Larrain)

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